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THE BRITISH AND EASTERN CONTINENTS edition of the Railroad Gazette is published each Friday at Queen Anne's Chambers, Westminster, London. It consists of most of the reading pages of the Railroad Gazette, together with additional British and foreign matter, and is issued under the name Railway Gazette.

CONTRIBUTIONS.—Subscribers and others will materially assist in making our news accurate and complete if they will send early information of events which take place under their observation. Discussions of subjects pertaining to all departments of railroad business by men practically acquainted with them are especially desired.

ADVERTISEMENTS.—We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay, EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and these only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers, can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially either for money or in consideration of advertising patronage.*

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VOL. XXXIX, No. 1. FRIDAY, JULY 7, 1905.

Good reputations are often ruined in a night, as they are often won in a day, but good character is stable. Those who have known Mr. John F. Wallace well—and there are thousands who have a more or less intimate acquaintance with his high qualities—cannot reconcile this knowledge with the intemperate scoring in which Mr. Secretary Taft has indulged. Surely all his admirers will agree with the remark of one who knows him best, made immediately after reading the Secretary's statement: "William Taft has not described John Wallace." The situation is pitiful. Here is a man of great accomplishment who has spent a long life in doing good work with distinguished ability, beyond criticism both as to motive and results. He is honored with an appointment that was rightly regarded as one of the highest rewards of a great engineer. After a brief service he comes to his superior officer to give his reasons for resigning and finds that officer in a rage, not at all interested in the reasons for the resignation, but indignant at the fact, and with a prepared libelous address to him which is at once given to the press. It is easy for a Cabinet officer, one of unusual power and repute, to break the heart of a subordinate, but, lacking a previous careful investigation of the facts and deliberate judgment, it was an unwise and brutal use of power. Mr. Wallace is a cruelly wounded man, and his loyal friends will need to know that he has done wrong before they believe it. Nevertheless, it seems clear that he made a mistake in the specific manner in which he managed his resignation. It was too abrupt, and the order in which the facts came to the public indicated a primary consideration for his own interest rather than patriotism. The chief engineer of the Panama Canal Commission is not a general at the front, and he has a right, which should be unquestioned, to sever his connection with the enterprise of which he is the operating head. But it is undoubtedly true that his work has a governmental—a national—character, which carries certain implied obligations not specified by contract, and not present in ordinary corporate positions. Not only the President and his cabinet, but the whole American people, feel keenly the responsibility of the task at Panama, and the importance to the national reputation of succeeding where another nation has failed. Mr. Wallace doubtless saw that the principal part of the work could be carried on without him; he doubtless failed to appreciate the moral effect of a precipitate resignation; of placing private duty above public duty, on everyone of his associates and fellow workers. It is easy to say that the necessary resignation of a chief engineer should not be made in a way that would damage the *esprit de corps*, yet at least in the early stages of the work Mr. Wallace had no more important task than to maintain the *morale* of his forces.

A suggestion about creosoted ties: They have, in the past, cost too much, and attention has been given to the possibility of using the cheaper woods found in the United States. We do not need to limit ourselves to the United States in the search for available material. Those learned in forestry tell us that before the middle of the present century our forests will be denuded by the present increasing rate of use. Canada has unmeasured forests of coniferous trees, whose logs will float and come to market cheaply. Most of these forests are doing no good in the world except to protect the soil. Their trees have arrived at the limit of natural production, for death and decay keep even pace with the natural growth. Virgin forest is benefited, not injured, by cutting out the big trees. Broadly, therefore, for the benefit of mankind, as well as for individual railroad interests, the Canadian forests will bear looking into. Specifically, a variety of Norway pine, known locally as "Princess pine," is found in quantities described as "inexhaustible," near enough to the border to cost little for transportation here. It is a comparatively dwarfed Norway, slower of growth and heavier. These Princess pine ties, 7 in. x 9 in. x 8 ft., can be delivered at a profit to railroads in the northern, easterly, states for something less than 50 cents each, and this includes the rather onerous ad valorem duty on importation. The wood "looks" as if it might be the best soft wood, spike-holding, tie known. This is not a scientific statement, and the subject needs further careful examination. Effective creosoting can now be done for within 20 cents per tie, so that this 70-cent tie may be expected to be protected permanently against decay, while its fibre gives promise of a life of more than fourteen years under heavy traffic. The cost of a Georgia pine tie is 60 cents—more or less—and it is not commonly expected to last more than nine years. It usually costs as much as 15 cents to transport and substitute a new tie. Anyone can figure out the rest of this arithmetic, so that it need only to be learned whether or not the Princess pine ties may have some practical defects.

Russian newspapers intimate that some of the state railroads may be sold to corporations or pledged for loans to the state. About 12 years ago the government began acquiring railroads, and has now built up a great state system, though the policy followed did not indicate that an exclusively state system was aimed at, at least not at present. Most of the railroads built by companies had dividends guaranteed by the government, and its experience with them seemed in many respects highly unsatisfactory. That the railroads worked by the state have been less or more so is not easy to decide, as many of them have been such as private enterprise would be least likely to undertake without a guarantee. From the accounts published, it would seem that very great advantage might result from a businesslike administration; but Americans and western Europeans are not likely to appreciate the difficulties in the way. In one respect Russia has avoided dangers which have wrecked hundreds of millions of capital in this country: it has not permitted the building of too many railroads in the same territory. Its railroads do not crowd each other even in the most productive districts. Thus they have, on the average, what we would call large earnings, though fares and freight rates are among the lowest

in the world. European Russia south of the latitude of St. Petersburg ought to be able to support three times as much railroad as it has now. The very long hauls from farm to station must require a large part of the time of men and teams, and offset the low freight rates. But the American capitalists who may be tempted by the prospects there must bear in mind that Russia and Russians are very different from America and Americans. A new railroad here with fertile country for 15 or 20 miles on each side for which it serves as almost the sole outlet is sure to have its traffic grow with very great rapidity. There, the country, though so far from cheap transportation to market, is likely to have been occupied and cultivated after a fashion for a century at least, and the production will be changed comparatively little and very slowly when it becomes more profitable.

TROLLEY FARES AND EARNINGS

In one of the International Railway Congress issues of the *Railroad Gazette* a paper was printed tabulating the rates of fare charged on certain through trolley runs. Since that time this inquiry has been carried further and returns have been tabulated from a number of other interurban lines (58 in all) representing every part of the country. The average fare per mile on these 58 through services is 1.38 cents. The list purposely excluded the rate of fare on the purely urban services of city lines. The passenger who travels the full distance possible for a five-cent fare in New York or Chicago, by making use of all the transfer privileges that are allowed him, will bring his average rate per mile to a figure considerably less than half this average. The additional fact that city lines do so large an amount of business in furnishing rapid transit as a convenience to persons wishing to travel only a short distance, paying a minimum fare of five cents, makes it quite impossible to reduce purely urban fares to any mileage basis for consideration, but the returns from these 58 interurban roads would certainly seem to indicate that there is a living profit in carrying passengers by trolley at a rate well under a cent and a half a mile.

The arrangement of the principal trolley companies in the United States in order of their gross earnings, which appears in the recent issue of *American Street Railway Investments*, adds some interesting data about the operating profits of electric lines, although no effort is made to separate city from interurban roads. In 1904, according to these figures, there were 43 companies with gross receipts of over one million dollars; the New York City Railway Company heading the list with gross earnings of $21,894,004, and the Philadelphia Rapid Transit Company coming second with gross earnings of $16,096,362. In 1903 there were 42 companies which earned over one million dollars; thus only one additional company has come into this class during the year; but the aggregate gross earnings of those included amounted in 1904 to $198,644,802, as against $169,394,001 in 1903. There were 30 companies in 1904 that earned between $500,000 and $1,000,000, as against 26 companies in this same class in 1903, and the gross earnings were $21,483,088, as compared with $18,019,575. The companies having gross receipts between $100,000 and $500,000 numbered 144 in 1904 and 100 in 1903, and earned $31,783,234 in 1904 and $22,875,139 in 1903. There were 106 companies that earned between $50,000 and $100,000 gross in 1904, as against 91 companies in 1903, and they earned $7,661,972 as against $6,428,530. The last classification is that of companies with gross receipts between $25,000 and $50,000. Of these there were 82 in 1904 and 51 in 1903, and the gross earnings were $3,183,982 as against $1,871,719. These figures are unfortunately not accurate. The 1903 figures were apparently revised for the current year, as they do not tally with the 1903 figures given in last year's collaboration; but it is impossible to use the new compilation of the results for 1903 because the companies which have passed the boundaries of a new class during the past year are not included in the returns for the previous year of the class they have left. Therefore, it has been possible to use only the new totals of the 1904 volume as compared with the new totals of the 1903 volume. In spite of this defect, the returns possess sufficient value to be very interesting.

Of the 43 companies compared in the first class (those earning one million dollars or over), only four showed decreases from 1903, and these decreases were not important in any case. Of the 30 companies in the next class, only two showed apparent decreases. Of the 144 companies earning between $100,000 and $500,000 in 1904, all increased over the year previous except 17; while taking the last two classes on the list together—representing 188 companies total—151 increased in gross and 37 decreased. The total earnings of the companies listed in 1904 amounted to $262,712,078. The total earnings of the trolley roads in these same classifications two years ago (in 1902) amounted to $201,593,401.

No good figures are obtainable to show the expenses of these same roads in the aggregate. Certain prominent lines made a bad showing. For example, the Massachusetts Electric Companies came out last year with a deficit, after paying reduced dividends, in place of a small profit balance in 1903 and a handsome profit in 1902. Other companies, such as the United Traction Company, of Albany, have been able to keep down both operating expenses and interest charges so as to show handsome increases in net income and surplus, year by year. It is unfortunate that the form of returns made by the trolley roads throughout the country is not uniform, so that careful aggregate statistics of anything except gross earnings are very hard to obtain.

An interesting commentary on the prevailing low fares on interurban lines has recently been made in the form of an agreement between the lines covering a considerable portion of Ohio to raise their minimum rate to two cents a mile. Twenty-one lines came into this agreement and proposed to sell interchangeable mileage tickets which are to be good throughout Ohio, Indiana and Michigan (*Railroad Gazette*, May 12, 1905). With the Ohio agreement in mind, together with the record of gross earnings and of fares charged, the figures at hand suggest some interesting questions, though they do not answer them. It is apparent that prevalent trolley fares are regularly made on a considerably lower basis than is thought possible by steam railroads; also that gross earnings have been increasing very rapidly on the electric properties throughout the country. The thing which is perhaps most necessary to know in forecasting the financial future of these roads is whether the properties, viewed as a whole, are being sufficiently well maintained out of earnings so that increased capital expenditure will not be necessary except where it may be expected to bring in new earnings. If they are not—and there is reason to fear that in many instances this is the case—another interesting thing to know is whether their earnings can be substantially increased by increases in fares, or whether low cost of transportation is their chief source of business. The recent action of the Cleveland lines will go a long way to help determine this. It seems quite safe to hazard a guess that the interurban lines have made themselves such a modern necessity by reason of their convenience, that they will be able to hold their business with a considerable increase in fares charged.

RAILROAD MOTOR CARS.

European practice and progress in the use of rail motor cars has been described and discussed frequently in these columns in the past year, and the field existing for their extended use in this country and some of the advantages to accrue therefrom have been pointed out. The general awakening of American roads to an increasing appreciation of the possibilities attending a proper development of this matter is evidenced by the many efforts being made to produce serviceable designs of autocars for steam road service. In recent issues brief descriptions have been presented of two American designs of cars, which represent two of the three available types, namely, steam, gasolene and gasolene-electric. Several designs of the second type—gasolene—are already well developed, the most notable being the Union Pacific car, described in this week's paper. Although these three designs will each be used on a different road, and the different conditions of working will preclude making any but general comparisons, the results from the trial of each in service will be awaited with considerable interest. The Union Pacific car has been working for about three months, but up to the present no systematic tests have been made to determine accurately its cost of operation in the service for which it is intended. However, the results of such trials as have been made thus far with it, prior to, and during a leisurely trip from Omaha to Portland, Ore., where it will go into reguar service, have satisfied the Union Pacific officers so well that six more cars are being built of larger capacity and containing such improvements as have thus far shown themselves to be desirable. Unofficial reports credit the car with a gasolene consumption averaging 3 quarts per car mile; the car has capacity for twenty-five passengers. The gasolene-electric car built for the St. Joseph Valley Traction Company by F. M. Hicks & Co., described April 21st, is now making 22 miles a day, hauling a 45 ft. trailer and some freight cars, on a gasolene consumption per car mile also of 3 quarts. The gasolene engine is 70 h. p., and in factory tests showed a consumption of one pint of gasolene per horsepower hour.

In discussions of the merits of the three types of motor cars,

it is not surprising to find that many motive power officers lean toward the steam car, expressing a belief that in the end it will be found more practical and satisfactory from the operating and maintenance standpoints than either of the other two types. It has been suggested by some that in a steam car burning crude oil would probably be found the ultimate solution of the rail motor car problem. They point to the good results in locomotive practice with crude oil in boilers not designed for its use, and argue that with a boiler scientifically designed to burn the oil to the best advantage, a chief present difficulty of the steam cars would be overcome. On a horsepower hour basis the cost of operation by crude oil is considerably greater than with coal, but less than with gasolene, at present prices for these fuels. The steam car is evidently the preferred type in England at present, despite the fact that they use a fireman, and a petrol car can, therefore, be operated with one man less, or only two in the crew. But the production of steam designs which enable the services of a fireman to be dispensed with causes this disadvantage of difference of crews to disappear, the Ohio River & Columbus car, described June 16th, being of that sort. Two-men crews, are, of course, out of the question with steam roads where the motor car service supplements the regular train service, three men, at least, being necessary to meet train rule requirements. The Chicago & Alton gasolene-electric car will carry a third man in the capacity of flagman. For a steam car in such service, this third man would have to be a fireman, as the need of keeping constant lookout ahead would make it unsafe to require the engineman to give any attention to the fire.

May Accidents.

The condensed record of the principal train accidents which occurred in the United States in the month of May, printed in another column, contains accounts of 12 collisions, 25 derailments, and two other accidents. Those which were most serious, or which are of special interest by reason of their causes or attending circumstances, occurred as follows:

		Killed.	Injured.
6th	Harrisburg, Tex.	2	0
11th	Lochiel, Pa.	23	109
11th	Warren, Pa.	2	2
12th	Weatherford, Tex.	0	20
19th	Kosoma, Ind. Ter.	0	15

The Harrisburg (Pa.) disaster, the second in the above list, has already been reported in the *Railroad Gazette* (May 19, page 163, General News Section, and June 2, page 594). No additional facts of importance have come out since except that (1) the train was composed of 68 cars, exactly one-half of which were air-braked; (2) the engineman applied the air-brakes only moderately (5-lb. reduction of pressure), and (3) the grade was slightly descending. Whether or not the car that buckled was weaker than those behind it is a point on which no information is vouchsafed. Since the accident the Pennsylvania has issued revised regulations for the transportation of explosives. Such shipments must be carried only in perfect cars, in trains of not over 30 cars, two-thirds air-braked; near the middle of the train but not within 10 cars of the engine.

The derailment at Harrisburg, Texas, on the 6th, was of a kind which has become rather familiar in the accident records of the Southwest—that in which a furious fire, fed by a tender-full of oil, quickly destroys the wrecked cars. The Warren (Pa.) collision illustrates once more the weak and ineffective way in which we carry out the principle of having two men of equal authority—a conductor and engineman—look out for the safety of trains.

The number of electric car accidents reported in the newspapers as occurring in the month of May was 23, in which eight persons were killed and 184 injured. There was the usual variety of causes, including the failure of power while cars were standing on railroad crossings and brakes failing on steep grades. Among the electric-car accidents was a collision, near Clearwater, S. C., which vividly illustrates the way in which the movement of heavy cars on steep grades is entrusted, on electric roads, to men who by reason of limited experience, or lack of experience, are unfit for such a delicate duty. In this case two men were killed and six were injured, two of them fatally. An Augusta paper thus reports the circumstances:

"Last night shortly after dark a special crew, composed of Motorman A. A. Whitmore, Conductor Gay and a negro brakeman, left the power house and proceeded to Clearwater, after a car of coal, to pull back to the power house. The trip out was successfully made, and the coal car, a heavy affair of the Louisville & Nashville railroad, was attached to the express car, which the special crew was operating. The trip back to the power house was about successfully made when the coal car started on its runaway career. The brakeman was down and opening the switch on to which the car was to be run. The switch had to be backed on to, and evidently in going over it, the coupling broke loose. The heavy coal car started down the hill, increasing its momentum at every turn of the wheels. The crew were unable to catch the car. They jumped to another and lighter power car and attempted to overhaul the runaway, but were unsuccessful. . . . Those left to tell the tale of the collision can only say that it occurred. The first they knew of their danger was when they felt the shock of the collision. There was no other warning. They do remember that the brakes were suddenly applied. The number of seriously injured was limited only by the fact that but few were on board. All in the car were caught like rats in a trap. There was no escape."

The *Journal*, of Atlanta, Georgia, says: "The state legislature should, at the coming session, take up the question of popular election of the railroad commissioners. These offices should be held directly from the people. It should not be possible to use them as political assets. The office of railroad commissioner is one of the most important in the state. The commission may exercise great power over the commercial and industrial destinies of the commonwealth. If the board is elected by the people it will be more responsive to the popular demand and more zealous in its advocacy of the popular interest, while if it is composed of men selected for the payment of political debts its members may feel inclined to let the public interest go and cleave to the political elements to whom they owe their tenure of office. If the railroad interests are able to dominate the politics of the state so far as to control a number of the chief executive offices, the railroad commission, which holds its office by appointment, will likely be a great deal more zealous in looking after the railroad interests than in protecting the popular interests. It may even become a sort of adjunct of the railroads. With a commission of this sort in power it is obviously harder for the people of the state to get a "square deal" than if there were no such thing as a commission. It may do more harm than it does good. Its chief function may be to block action." We fear that the *Journal's* remedy would be as bad as the disease. A commission that is appointed by a Governor who is favorable to the railroads is likely to "block action"; but how about one elected by the people? It will be likely to go as far in the other direction; to take such radical action that it will need blocking itself—by the courts. It will, perhaps, have a better heart for giving the people what they ought to have, but not so good a head. The people are prone to elect men who promise to be good advocates, rather than those who are of judicial mind; and advocates usually do nothing with the railroads but dispute with them. If a Governor uses railroad commissionerships to pay political debts, the Governor himself needs to be reformed. Does the Governor use judgeships for that discreditable purpose? If the people of a state cannot elect an independent Governor, what likelihood is there that they can elect strong men for railroad commissioners? That is the real need in making up any railroad commission—strong men. Whether or not that is the trouble in Georgia we shall not undertake to say; but as the Commission in that state has lately refused to comply with the request of Atlanta people for certain radical reductions in freight rates, one naturally queries whether the *Journal's* complaint may not be due to the presence of too much strong-mindedness in the Commission rather than too little.

All the old box cars, fences and things unsightly in any degree on the Baltimore & Ohio line between Pittsburg and Chicago, where it is double-tracked, are to be removed, the right of way to be made a thing of beauty, with flower beds around stations, and hillsides (cuts) graded and sodded.

The foregoing, clipped from an Ohio paper, conveys most pleasing intelligence. Would that it could be said of a hundred other railroads! Whether or not the statement must be taken with the grain of salt which sometimes needs to be taken with advertising agents' announcements we do not know; but we will assume that it does not. That double-track proviso is a bad enough grain of salt. What is the matter with beautifying a single-track division now and then? Why are old box cars named first in the list of unsightly things? We do not know. How an old box car looks under the genial suns of Ohio we cannot accurately state. But on a certain large road in another state this disfigurement would naturally be put first on the list, because it *is* first by its nature. And two box cars, one atop of the other, making a two-story shanty, may fairly be termed "the limit," especially when the combination is freshly painted a glaring salmon. The most encouraging words in this B. & O. item are "all" and "any," in the first two lines. Next to a constant succession of slovenly grounds along a railroad, is a road with just enough flower-beds to emphasize the disagreeable sights by contrast. A roundhouse or a watchman's hut, which is so dingy and neglected as to cause ladies in the parlor cars to look the other way, often becomes actually worse by putting too smart a face on a few square yards of the grounds around it. There is too strong an impression that the bosses of different departments of the railroad do not "consist."

Mr. George Rice is dead; but the soul of his fight against the Standard Oil Company goes marching on. The Gulf Refining Company, a dealer in Texas oils, has complained to the Interstate Commerce Commission that the Illinois Central, the Louisville &

Nashville, and the C., N. O. & T. P., carry petroleum oils from Louisville southward to New Orleans, for 18 cents per 100 lbs., while from New Orleans northward to Louisville the rate is 35 cents; and Cincinnati, Chicago and other places are favored in the same way. At the same time cottonseed oil is carried northward at about the same rates as petroleum oils southward; and the roads are accused of acting in concert to unlawfully prevent complainant from selling Texas oil in the north, although the northern cities want it. This case will furnish the material for an interesting study. The cheap rates for petroleum south and cottonseed oil north have been made, undoubtedly, to develop business; but why should not the Texas oil business be developed with equal assiduity? It would be worse than carrying coals to Newcastle to carry oil a thousand miles northward and other oil a thousand miles southward over the same line and in the same cars; and yet such ideally perfect use of cars appears to be one of the reasons why, according to the complainants' statement, their oil ought to be carried more cheaply than it is. Certainly it ought to be good for the railroads to thus exchange commodities, for to exchange commodities is a chief reason why they have been built. But is there really such a difference between northern oil and Texas oil as to justify this costly transportation? To the ordinary man, to whom all oils look alike, it would seem as though the territory ought to be divided, giving the southern half to the Texas people and the northern half to the northern producers. But that proposition would introduce the question of volume of traffic, the personal preference of purchasers, and intangible differences in the qualities of different oils. Evidently nothing less than an investigation by Commissioner Prouty will serve to illuminate this illuminant.

Riding in a runaway trolley car down a steep hill is quite likely to be injurious to one's health, for a cracked skull or a crushed leg or foot may cause insanity or blood poisoning; but we should hardly have thought of asking the public health authorities to prevent runaways. That, however, is just what has been done in Yonkers, N. Y., as appears from the following press despatch: "While traffic on the trolley cars was at flood tide yesterday afternoon, the cars being jammed with passengers going to the automobile races, Police Captain Woodruff and Health Officer Mulligan held up fifteen trolley cars at Getty Square and ordered them back to the depot. No heed was paid to the protests of the passengers, and the cars went back. Dr. Mulligan said that some time ago the Board of Health passed an ordinance requiring all cars to have sandboxes in good working order, and filled. The cars sent back were not equipped with sand, and were therefore dangerous to the crowds being carried. Yonkers is a hilly city, and on wet or rainy days it is dangerous to run the cars without sand." The acts of health officers frequently seem extreme, and even unnecessary or oppressive; and some of the laws under which they act are ill-judged; but we shall not quarrel with this one, illogical as it may seem. It is good that the Yonkers Board had the "sand" to enforce their rule.

TRADE CATALOGUES.

Brake-beam Stresses.—The Damascus Brake-Beam Co., St. Louis, Mo., publishes a pamphlet on this subject under the title of "Transverse Strain." It is a copy of a report made several years ago by Mr. H. M. Perry to a beam manufacturer, after investigating a large number of brake-beams on cars. The report is accompanied by diagrams and photographs, which are reproduced. The pamphlet also illustrates the "Waycott" trussed beam, and shows a sample beam in the testing machine at Purdue University.

Pinch-Bar or Car Propeller.—H. J. Gehr, Waynesboro, Pa., sends a folder which illustrates and describes an ingenious tool known as the "Gehr" car propeller. This tool is designed for moving cars by hand and is provided with a device which automatically clamps it to the rail head and thus prevents it from slipping while under pressure.

Spray Nozzles, Injectors, Etc.—The Schutte & Koerting Co., Philadelphia, Pa., sends several folders which illustrate and describe its spray nozzles, which are used for cooling condensing water; its Universal double-tube injector and the Schutte-Koerting educator condenser.

Oil Engines.—The De La Vergne Machine Co., New York, sends a folder descriptive of its "Hornsby Akroyd" oil engines. It contains figures regarding the cost of operation as well as illustrations of the engines which are made in sizes ranging from 1½ h.p. to 125 h.p.

Valves.—The Crane Co., Chicago, sends its special railroad number of *The Valve World*, in which is described the power plant of the Railway Exchange Building, Chicago. It also contains an illustrated article by O. F. Bell entitled "Illinois and Chicago's First Railroad." It also contains illustrations and brief descriptions of some modern locomotives, as well as its usual amount of light reading matter.

CONTRIBUTIONS

The First Steel Car.

New York, June 29, 1905.

To the Editor of the Railroad Gazette:

In your issue of June 16 last, considerable space is devoted to a description of steel passenger cars. In the interest of historical accuracy I am venturing to correct a statement in your editorial upon the subject, which reads to the effect that the first "all-steel passenger cars" put in actual service were the side-entrance suburban cars on the Illinois Central, which you state antedate some months the Gibbs type of car used on the New York Subway.

The Illinois Central cars are of the steel frame type, but cannot be called an all-steel car in the same sense that the New York Subway cars can. The Illinois Central car uses a steel upper frame for structural reasons, but uses wooden sheathing and inside trim. The Subway cars are all-steel and of fireproof construction throughout. The outside sheathing is of steel and forms an integral part of the frame; the inside treatment is of metal backed with asbestos; the floor is of steel and plastic cement, to be proof against both fire and electric arcs.

My first all-steel fireproof passenger car was designed in 1902, and constitutes, I believe, the first attempt to reduce to a practical proposition this form of construction. At the present date even, I believe my cars on the New York Subway are the only metal and fireproof passenger-carrying vehicles in regular service anywhere. Since the first order for these cars was given by the Subway, my design has been adopted for electrical service on the Long Island Railroad, the New York Central Railroad, and on one of the London underground roads. That the use of strictly all-metal passenger cars will become general in electric service I have no hesitation in predicting, and I further believe this form of construction will quickly demonstrate its advantages over wood framing for passenger-carrying vehicles on steam roads generally.

I do not wish to detract in the least from the credit due Messrs. Sullivan and Renshaw in successfully developing what is probably the first practical steel frame passenger car, but I believe to the Interborough Rapid Transit Company of New York City should be given the credit in an historical record of being the first railroad company to adopt and place in service a successful all-steel, fire and electric arc-proof passenger car.

George Gibbs.

Cast-Iron Wheels.

New York, July 5, 1905.

To the Editor of the Railroad Gazette:

The writer has read with interest the paper on "Cast-Iron Wheels," by Mr. J. E. Muhlfeld, which was printed in the *Railroad Gazette*, May 5, 1905. Also, the cast-iron wheel-makers' petition to the Master Car Builders' Association at the convention held last month. The question is one of grave importance. Perhaps nothing relating to railroad equipment is of so much importance as this at the present moment.

While a wheel of cast-iron, properly made, of good material and design, might be considered economical and comparatively safe for freight equipment, where such equipment did not exceed 60,000 lbs. capacity, it is obvious that if it is barely strong enough for that service, it is wholly inadequate for a 100,000-lb. car, or else it is unnecessarily strong for the 60,000-lb. car, which all railroad men know is not the case. The experience of all railroads with cars of 100,000 lbs. capacity is, that their wheel mileage for this class of car has been greatly reduced, which means inevitably an increase of accidents from wheel breakage, and, consequently, a greatly increased mileage cost due to this decreased mileage and accident expense. All of this has occurred and is occurring, notwithstanding the fact that the weight of the cast-iron wheel has been increased, nor does it seem reasonable that the increase of weight of the cast-iron wheel will remedy the difficulty, for the reason that the heating of the wheel by brake-shoe friction and rail contact causes seams and cracks to develop in the throat and across the rim, resulting in broken flanges, rims and plates. This being true, a wheel for this heavy service should be made of a material that is intrinsically stronger and consequently safer than cast-iron. Mr. Muhlfeld's argument is in favor of trying to improve the cast-iron wheel by making some changes in designs, but the fact is that the best that can be done in this regard will not produce a wheel of more than about one-fifth the strength of a steel wheel, in so far as its ability to resist breakage or cracks is concerned.

Specifications, guarantees, inspections and tests, such as Mr. Muhlfeld recommends, are proper and in the main have been in existence a great many years, but it does not alter the fact, nor

can it, that in the case of cast-iron, the tensile strength, without any elongation, is probably 25,000 lbs. per square inch, and in the case of a pressed and rolled steel wheel, from 110,000 to 125,000 lbs. The margin of safety in the latter is so great that the absence of liability of breakage is apparent. As a proof, however, of the enormous differences between the pressed and rolled steel wheel and cast-iron wheel, both with regard to its ability to resist shock and to resist the detrimental effects of the heat action, I give below the result of, first, a thermal test, and, second, a drop test, both of which were suggested by Mr. Muhlfeld:

Thermal Test.

2-in. of molten metal poured around the rim.

33-in. wheel from heat No. 80.			33-in. wheel from heat No. 86.		
Pouring	12	sec.	Pouring	11	sec.
Ring broke in	2	min.	Ring broke in	3	min.
Ring taken off in	3	min.	Ring taken off in	4½	min.
Pouring	10	sec.	Pouring	11	sec.
Ring broke in	3	min.	Ring broke in	2½	min.
Ring taken off in	4	min.	Ring taken off in	3½	min.
Pouring	9	sec.	Pouring	9	sec.
Ring broke in	2½	min.	Ring broke in	3	min.
Ring taken off in	3½	min.	Ring taken off in	4	min.
Pouring	10	sec.	Pouring	10	sec.
Ring broke in	2	min.	Ring broke in	2	min.
Ring taken off in	3¼	min.	Ring taken off in	3½	min.
Pouring	15	sec.	Pouring	14	sec.
Ring broke in	3	min.	Ring broke in	3	min.
Ring taken off in	4	min.	Ring taken off in	4	min.
Pouring	10	sec.	Pouring	10	sec.
Ring broke in	3½	min.	Ring broke in	3	min.
Ring taken off in	5	min.	Ring taken off in	5	min.

Measurement after cooling revealed no difference in dimensions in any of the tests. An interval of 24 hours elapsed between each test, to allow the wheels to cool. It will be noted, also, that double the quantity of molten metal was used as compared with ordinary cast-iron practice, as well as six applications as compared with one in cast-iron wheel tests.

The analyses of these wheels are as follows:

Wheel No. 1, from heat No. 80.	Per cent.	Wheel No. 2, from heat No. 86.	Per cent.
Carbon	.70	Carbon	.65
Phosphorus	.026	Phosphorus	.018
Manganese	.67	Manganese	.75
Sulphur	.036	Sulphur	.039
Silicon	.220	Silicon	.165

Drop Test.

A 36-in. wheel was placed in an upright and running position, under a drop weight of 2,200 lbs., the distance traveled by the weight in descending being 8 ft. It was given 12 blows in this position, and, turning the wheel partially around, but still in an upright position, subjected to 12 more blows, and after a third partial turning was given an additional 12 blows. This treatment produced absolutely no effect on the wheel, aside from some insignificant local displacements of metal where the drop came in contact with the wheel.

The wheel was then placed flat and given 12 blows, without injuring it in any way. It was then turned over and given 12 more blows. This was the extent of the test. Measurement of the wheel after taking it from the drop failed to discover injury in any way. Its roundness had not been affected and the coning remained identically the same as when it was placed under the drop.

It does not appear to be a debatable question as to which type of wheel should be used, both for economical purposes as well as safety. The latter should always take precedence where life as well as property is at stake. Railroads, however, have not been to blame in this matter, because steel wheels, such as the writer refers to, have not been produced in quantities which would supply the wheels for 100,000-lb. capacity cars.

The wheel manufacturers committee in their petition to the Master Car Builders' Association make the following statement:

Comparison of car wheels, past and present, and their construction and requirements of service as presented at the Cleveland meeting:

Capacity of car. Pounds.	M. C. B. standard finished wheel fit. Inches.	Cubical area.	Weight of wheel in common use. Pounds.
24,000	4⅛ x 7	13,364	525
28,000	4⅛ x 7	13,364	550
40,000	4⅞ x 7	18,665	580
50,000	5⅛ x 7	20,629	500
60,000	5⅜ x 7	22,690	600
80,000	6⅜ x 7	31,909	625
100,000	6⅞ x 7	37,122	650

Comparison of 12-ton capacity equipment with 50-ton capacity equipment:

Increase in cubic area, finished wheel fit	177 per cent.
Increase weight of rails	100 " "
Increase weight of wheels	23 " "
Increase:	
Load capacity; formerly 24,000 lbs., now 100,000 lbs.	76,000 lbs.
Tare weight of car; formerly 18,000 lbs., now 28,000 lbs.	10,000 "
Permitted excess load (10 per cent.); formerly 2,400 lbs., now 10,000 lbs.	7,600 "
Total, additional load	93,600 lbs.
	Or, 375 per cent.
Increase in time guarantee (2 yrs. to 4 and 5 yrs.)	125 " "
Increase in annual mileage of cars	100 " "
Total increased requirements of our wheels	600 per cent.

Six hundred per cent. increased requirements for a cast-iron wheel with only an increase in weight of 23 per cent. has put a burden on cast-iron wheel makers too much for them to bear, and it is not at all certain that the 23 per cent. additional weight gives 23 per cent. additional strength, because of the difficulty of putting the weight in the proper place. It is, therefore, no wonder that they are petitioning the Association to have the guarantee reduced to a fraction of what they are willing to guarantee a wheel for 60,000-lb. cars.

In brief, the cast-iron wheel makers might just as well have said "we cannot make a cast-iron wheel to safely carry a 100,000-lb. load," for when they refuse to guarantee the wheel for that service, they have in fact said they cannot make it.

The following table of tests of cast-iron wheels for flange breakage, which the cast-iron wheel makers committee submitted, is most significant as showing the unreliability of the combination of chilled and soft iron in the wheel tread and flange:

Results of Flange Tests.

No. of test.	Breaking load.	No. of wheel.	Point of application of load on flange.
1	52,850	H. 19,413	Between brackets.
2	47,750	H. 19,413	Opposite bracket.
3	49,350	H. 19,413	Between brackets.
4	53,400	H. 19,413	Opposite bracket.
4a	105,000	H. 19,413	Load applied on rim; no fracture.
5	62,850	H. 19,410	Between brackets.
6	48,700	H. 19,410	Opposite bracket.
7	58,250	H. 19,410	Between brackets.
8	58,000	H. 19,410	Opposite bracket.
9	74,850	H. 19,254	Between brackets.
10	72,200	H. 19,254	Opposite bracket.
11	87,000	H. 19,254	Between brackets.
12	68,550	H. 19,254	Opposite bracket.
13	99,300	A. C. & F. Co., wheel 650	Between brackets.
14	100,000	A. C. & F. Co., wheel 650	Opposite bracket.
15	105,000	A. C. & F. Co., wheel 650	Between brackets.
16	68,200	A. C. & F. Co., wheel 650	Opposite bracket.
17	79,350	A. C. & F. Co., wheel 650	Opposite bracket.
18	52,300	H. 19,558	Between brackets.
19	111,600	1904 M. C. B. pattern (tape 1) 700.	Opposite bracket.
20	87,000	1904 M. C. B. pattern (tape 1) 700.	Between brackets.
21	109,900	1904 M. C. B. pattern (tape 1) 700.	Opposite bracket.
22	98,900	A. C. & F. Co., wheel (tape 2) 700.	Between brackets.

From the above it will be seen the average strength to resist flange breakage is 80,000 lbs., but the significant point shown by this exhaustive test is the variation in the strength, ranging all the way from 47,750 to 111,000 lbs. More than 55 per cent. difference in the strength of wheels is undoubtedly a grave defect. A test for flange breakage of a Schoen pressed and rolled steel wheel was made by Mr. Geo. L. Fowler, M.E., under similar conditions to those used in the cast-iron wheel tests referred to above, with the result that it took 554,000 lbs. pressure to break it.

The specifications, inspections and tests of cast-iron wheels are about as severe as it is possible to make them, and the cast-iron wheel makers were compelled to make the confession in their petition to the Master Car Builders' Association that they cannot make a better wheel, and that it is not good enough for the 100,000-lb. capacity cars is conclusive from the fact that they refuse to guarantee them for more than one-third of the mileage that they guaranteed for the 60,000-lb. car wheel.

The question is, what is to be done about it? To my mind there is but one solution, and that is, to make wheels of steel. The extra expense involved is more imaginary than real, because, as a matter of fact, on a mileage basis a pressed and rolled steel wheel can be produced, and is being produced, that can be sold at a price that would make the wheel cost per thousand miles about equal to that of cast-iron, and in addition be safe.

With regard to the use of cast-iron wheels for passenger service, the practice is wholly indefensible. Certainly from a point of safety there can be no comparison between a cast-iron and a steel wheel, and as to the question of expense, there is absolutely no difference. If anything, the steel wheel can make the mileage of a cast-iron wheel for less expense.

Mr. Muhlfeld's statement that it would make a difference of $200,000,000 in investment if steel wheels were used is somewhat misleading, for the reason that the necessity for equipping cars of 60,000 lbs. capacity and under, apparently does not exist, and is applicable only to 80,000 and 100,000 lbs. capacity cars. There are probably 200,000, or say, 250,000 cars of this capacity in use, and the additional investment for steel wheels over the cast-iron wheels with which they are equipped, would probably not exceed $15,000,000 to $20,000,000, all of which would be more than saved in increased mileage, and in addition there would be safety against wrecks.

Mr. P. H. Griffin points out the fact that by using over and over again the old cast-iron wheels for making new ones, the metal in the new wheels is continually retrograding in quality, and consequently the new wheels must be getting poorer in quality from year to year. Comment on this point is unnecessary. It speaks for itself.

The writer was the first to develop and exploit the substitution of steel freight cars of 100,000 lbs. capacity, in a substantial way, and through that experience learned quickly that to build a 100,000-lb. capacity car entirely of steel and leave the very foundation (the wheel) of cast-iron, was immediately demonstrated by excessive failures of the cast-iron wheel to be radically wrong. Furthermore, it is a fact that the full earning capacity of 100,000-lb. steel cars is not obtained under present wheel practice.

My faith in the rolled-steel wheel as an economic proposition for railroads is so great that, single-handed and alone, I have spent nearly three-quarters of a million dollars in developing the enter-

prise, and with reasonable support from railroad officers, the old system of making car wheels for large capacity cars, fast freight service, and passenger equipment, will in the near future be entirely revolutionized.

CHAS. T. SCHOEN.

Locomotive Valves and Valve-Gears.*

1. What the human heart is to the body, the valves are to the locomotive. It is their function to control the circulation of the energizing vapors throughout the organism of the machine. When they perform well their functions, the locomotive is prompt and precise; if they are faulty, it limps on its course, or allows its energies to run to waste. From the early days of locomotive operation, valves and their gears have challenged alike the skill of practical mechanics and of the professional engineers. Most men who have had to do with the operation of locomotives and whose abilities have been such as to make them responsive to their surroundings, have at some time in their life, been interested in the introduction of some new type of valve or valve-gear. It goes without saying that much of this effort has been misdirected and it has not infrequently happened that proposed improvements have involved misconceptions concerning fundamental principles. In view of this fact, and because of a very common interest which attaches to the problem, it will be profitable to discuss briefly the present state of valve practice and to inquire as to its tendencies.

The valve-gear of a modern locomotive contends with conditions which are difficult to meet. It is designed to so move the valve it drives as to open the port by an amount which at running cut-off, usually does not exceed three-eighths of an inch, and at speed, the entire interval during which any port is open is less than a twentieth of a second. If normal steam distribution is to be maintained, the valve must move with great precision, since even a slight change in the extent of its travel, or in the time of its action, becomes relatively large when measured by the small port opening and the brief interval during which the port is open. Moreover, a valve of a modern locomotive weighing with its yoke 150 lbs. or more, requires the application of forces of considerable magnitude to give it motion, and its action involves more than ten reversals in its motion each second. It is necessary that the gear which actuates such a valve be free from lost motion, and that it be so stiff as to admit of no deformation of its parts. With this understanding of the requirement, we shall do well first to examine that type of valve-gear which is common in American practice, and to review briefly its merits and defects.

THE STEPHENSON VALVE-GEAR.

This gear, which is so familiar to all that I have no need to illustrate it, as designed to drive a flat valve, contains ten joints between the axle and the valve-yoke, having motion when the gear is in action. Lost motion in any of these will modify the valve action. Accurate fitting and the use of case-hardened parts have, however, made the joint of the link-motion reasonably satisfactory, but the average gear leaves much to be desired, in the way of stiffness. It is true that great progress has been made in this latter respect. The modern engine does not slow down on the hill, when the throttle opening is increased, as used sometimes to be the case with locomotives having bent and limber eccentric blades, but even in the modern locomotive the spring of parts has not been entirely eliminated. The principal defect at present is in the link and its support. The heavy valves now in use, in combination with the angular position with reference to the motion of the link-block, occupied by the link when the cut-off is short, impose heavy stress upon the link hanger. The fact that this is attached to one side of the link leads to the introduction of twisting strains which affect the whole system. The remedy is to be found in a more general adoption of the marine type of link, with double hangers, giving support to the link upon both sides, and having connection with a very heavy reverse shaft and arms.

The motion communicated to the valve by the Stephenson gear is one which, beginning from rest, increases to maximum and then gradually diminishes until at the end of its travel, it comes to rest again. The fact that it approaches its point of rest, and upon reversal recedes therefrom with a relatively slow motion, permits the valve to be controlled in its course more easily than would be the case if its changes in velocity were in obedience to a more complicated law. The gradual change in its rate of motion may well be seen in a curve representing the relative movement of valve and piston. Figure 1.

In the diagram of this figure, which is usually referred to as a valve ellipse, horizontal distances represent piston displacement, and vertical distances valve displacement. The figure shows two ellipses corresponding with two different positions of the reverse lever. Distance between the heavy horizontal center line and the upper portion of either curve indicates the distance which the valve is removed from its central position, and distances along the center line represent piston displacement; thus, in the original diagram from which Figure 1 was made the distance along the line A B from the center line to the heavier lined curve, is one and three-fourths inches. If we subtract the outside lap of the valve from this distance, the result will be the port opening. Thus, in the present case, the outside lap is one and one-half inches, so that the port opening on the line A B C D is one-fourth inch. In the particular case in question, the shaded area represents both the time and extent of the port opening. As many valve ellipses can be made as there are notches in the quadrant holding the reverse lever. Again, while I have referred only to the steam port opening, it should be evident since the displacement of both valve and piston are shown, that the time and extent of the exhaust-port opening can be determined as well as that for the steam port.

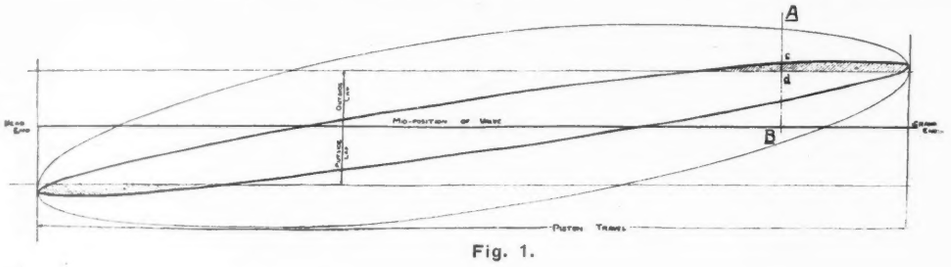


Fig. 1.

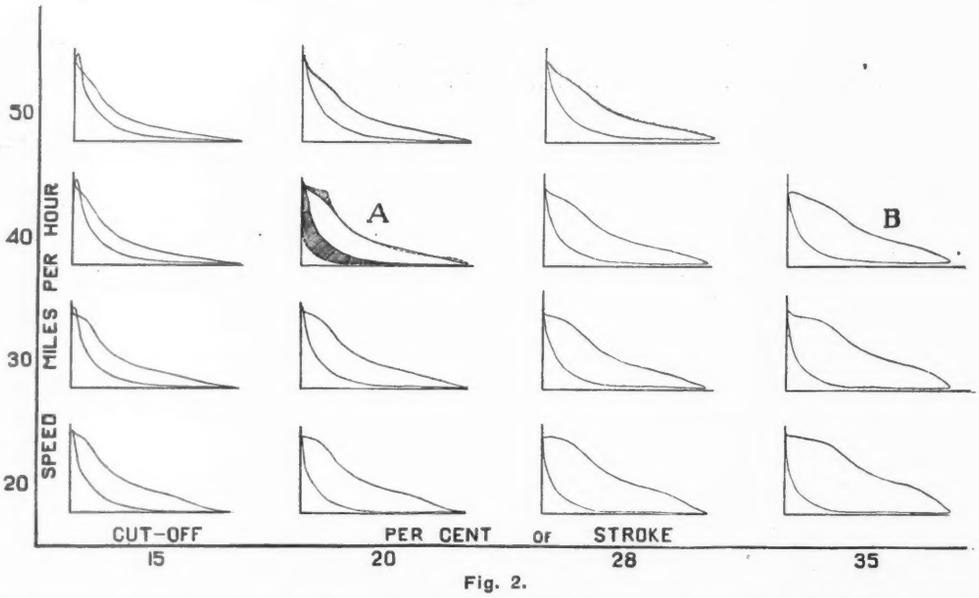


Fig. 2.

The present purpose is less concerned with questions of port opening than with the form of the curve representing the motion of the valve, for I wish at this point to discuss briefly a modification of existing gears designed to accelerate the valve motion when the piston is at the end of its stroke. It is the purpose of the class of devices to which I refer, to secure a quick and liberal opening of the port to hold the valve nearly stationary during admission, and-

*A paper read before the Southern and Southwestern Railway Club, by Prof. W. F. M. Goss.

to close the port promptly at cut-off. The mechanical arrangements for securing these results usually consist of the addition of mechanism to existing valve-gears. A number of different gears have from time to time been proposed and used. While the means employed vary greatly in different gears, the form of the valve diagram will be much the same for all. In contrast with that shown by Figure 1, it will be a figure having the same total length and the same total width, but with ends much flatter, indicating the higher velocities of the valve on either side of its points of reversal. It is evident that increased acceleration requires a gear which is stiffer than that which is usually employed. This fact, together with a knowledge of the care which must be exercised in the construction and maintenance of normal gears, suggests some of the difficulties to be met in designing and maintaining any of these accelerating devices. The conception underlying the accelerated device is good, but the locomotive is an extremely difficult type of engine upon which to employ it. The fact that in locomotive service the valve travel is considerable and the speeds are ofttimes enormously high, makes it difficult to say just how far a design may be carried to secure such stiffness of gear, and increase of wearing surfaces as may be required to perform the work imposed by any of the devices in question.

Another point to be emphasized in connection with the valve ellipse is the small extent of port opening. The smaller of the two ellipses shown represents a cut-off of 20 per cent. of stroke. The greatest width of the shaded portion on a full-sized diagram in one-fourth inch, which is the maximum steam-port opening at this cut-off. With longer cut-offs the travel of the valve is increased,

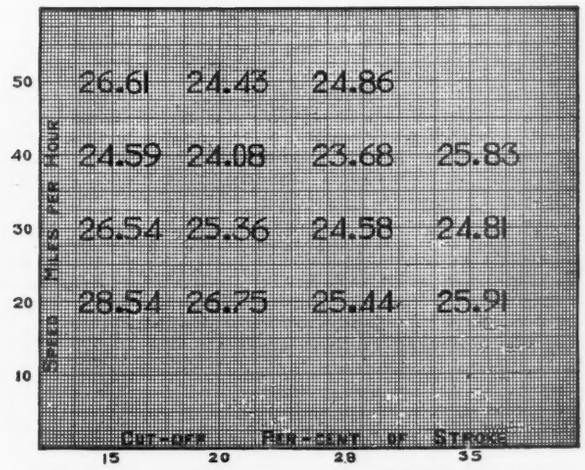


Table 1.

and the port openings become greater, but the fact remains that at running cut-offs, the opening is small.

The effect of small port-openings upon the form of the card will be seen by reference to Figure 2. The several cards of this figure are plotted in terms of speed and cut-off. Referring to them first by horizontal lines, those which are lowest, were made at a speed of 20 miles an hour; the next highest 30 miles, the next 40 miles, and the highest 50 miles. Viewing them in vertical lines, those at the extreme left represent a cut-off of 15 per cent. stroke, the next 20 per cent., the next 28 per cent., and the last 35 per cent. The wire-drawing effect may, for the purposes of illustration, best be seen from the four cards at 20 per cent. At the slow speed of 20 miles an hour, the events of the stroke are well marked, but as the speed increased, the points representing change of pressure are less clearly marked, and at 50 miles, as shown by the highest card, the events of the stroke cannot be located. Similar results appear in the cards for 28 per cent. stroke and for those at 35 per cent. stroke. All this is the effect of wire drawing, and is typical of the Stephenson link motion. It is an indication that as the velocity both of the piston and valve increases the changes of pressure within the cylinder lag behind, the form of the card approaching a smooth curve and its area diminishing.

The fact that with a given cut-off, the cards must diminish in size, as the speed is increased in the manner shown by the diagram, Figure 2, may be made apparent from several points of view. Thus, it may be said that with each increment of speed, the duration of each stroke is shortened, and hence the amount of steam which can enter a given opening of port becomes less. Again, it may be made apparent by considering that with a given cut-off the fraction of the whole time which the port is opened is independent of speed. In an hour's run, there will be a certain definite number of minutes that each port will be open, whatever may be the speed; hence the volume of steam passing a port in a given time is constant except in so far as the flow may be modified by the conditions of pressure existing within the cylinder. With the total volume passing, approaching a constant, it is evident that when the number of strokes increase, the amount admitted per stroke must diminish. It is, therefore, entirely clear that any valve actuated by a Stephenson link motion, unless designed to give port openings which will be excessive for slow speeds, must give rise to wire-drawing at higher speed.

It is commonly assumed that all wire-drawing in locomotive service is objectionable; whereas, there is one very useful service which it renders. It is that of assisting in the maintenance of uniform conditions upon the boiler while the engine is operating under widely varying conditions of speed. The significance of this statement will appear if we assume an engine at a speed of 20 miles an hour with reverse lever and throttle set to make the demand for steam such as to put a fair working load on the boiler. If, now, by a change in grade, the load is diminished sufficiently to permit the speed to increase to 40, 50 or even 60 miles an hour, it will generally not be necessary to change the reverse lever or the throttle, the wire-drawing action coming into play to prevent the cylinder from taking from the boiler more steam than it can supply, the engine meanwhile continuing at all speeds, to work at or near its maximum capacity. This automatic regulation of power through wire-drawing is, I believe, one which means much both as a matter of convenience in the operation of the locomotive and as a factor affecting boiler repairs. In seeking to improve valve-gear practice, it will always be well to remember the fact that it is the wire-drawing action which permits a locomotive to run without any change in the adjustment of throttle or reverse lever at widely varying speeds, developing all the time a close approach to its maximum power.

But there are objections to wire-drawing which are real and sometimes serious. These arise from the fact that as the process proceeds, the cylinder action becomes less efficient. While the loss on this account is smaller than is generally supposed, it is well that the facts be understood. These may best be apprehended by comparing the steam used per horse-power hour for different speeds. Values as obtained in the tests represented by the cards, Figure 2, are shown by Table 1.

Accepting for purposes of comparison, the results corresponding with a cut-off of 28 per cent., the values are as follows:

Speed 50, Steam per I. H. P. H., 24.9.
Speed 40, Steam per I. H. P. H., 23.7.
Speed 30, Steam per I. H. P. H., 24.6.
Speed 20, Steam per I. H. P. H., 25.4.

Results for other cut-offs are substantially the same. At 60 miles an hour, were the data available, the consumption would probably rise to 27 lbs. It is a principle in steam engineering that, other things remaining the same, the steam consumption should diminish with increase of speed. This principle would apply in locomotive service were it not for the fact that with each increment of speed there is a change in the distribution of steam. The result is that while the steam consumption diminishes until a speed of 35 or 40 miles an hour is reached, after this point it increases, the losses through wire-drawing being greater than the thermodynamic gain due to the increase of piston speed. Referring to the figures above, there can be no doubt but that the change from 23.7 lbs. to 24.9 lbs. is due to wire-drawing. If for this series of tests the steam consumption had been obtained for a speed of 60 miles, it would have shown an increase in steam consumption of 2 lbs, or, say 10 per cent. above the minimum.

In conclusion, therefore, with reference to wire-drawing, with increase of speed, it may be said that its presence is a necessary accompaniment of valves and gears now common; that is, serves a useful purpose in regulating the demands which the cylinders make upon the boiler, but that, at the highest speeds, is is responsible for some increase in steam consumption.

IMPROVED VALVE GEARS

From the beginning of locomotive valve-gears, countless devices have been proposed affecting either the valve or the gear which gives it motion, whereby the card may be made larger than that which results from the normal link-driven plain valve. A typical improved card is shown at A, Figure 2. Concerning such devices, I would note that it is usually assumed, though the assumption is erroneous, that anything which increases the area of an indicator card is desirable. For example, in Figure 2, for 20 per cent. cut-off and a speed of 40 miles an hour (card A), the plain outline is the normal card around which has been drawn a so-called improved card. The difference is the shaded area, and is presumably the result of the adoption of some new form of gear. Obviously, the shaded area represents increase of power. The first mistake that is made concerning the change is that the increase in power results in no expense. Again, while the truth of the preceding statement may be admitted, it is often urged that one may measure pressure and volume represented by two indicator cards, such as are shown by Figure 2, and derive therefrom an estimate of the relative amount

of steam used per horse power per hour under conditions which each represent. Such estimates are in fact fairly reliable when made between cards agreeing closely in form, and when all conditions of running are the same, but as a general proposition, nothing is more misleading. If there are differences in speed, or in initial or final pressure, or in the number of expansions, the percentage of the total amount of steam used which is shown by the indicator will change. Anything which may produce a change in the temperature of the metal of the cylinder at any one point in its cycle is likely to produce changes in the whole cycle. As is well known, a considerable percentage of the steam drawn from the boiler for each stroke of the engine, condenses on entering the cylinder. While the interchange of heat causes some change in the amount of water in the cylinder as the piston proceeds on its course, by far the larger part of the initial condensation continues in the cylinder until the exhaust port is open, when it flashes into steam and disappears with the exhaust. While the process is a complicated one, and cannot within the limits of the present paper be accurately defined, the fact is that any change in the form of any line bounding an indicator card has its effect upon the amount of steam which must be admitted to make up the loss due to initial condensation. A change in the cycle remote from the period of admission may have as pronounced an effect on the quantity of steam required, as a change in the period of admission itself. There is, in fact, no way to measure performance of a steam engine, but by weighing of the feed or the exhaust. Again, a further illustration of the fact that the mere increase in the area of an indicator card is not significant, is to be found in the ease with which such increase of area may be secured. In locomotive practice, it is quite unnecessary to adopt a new gear. If, under the conditions prescribed, the normal card (Figure 2), is not large enough for the work, the reverse lever may be advanced on its quadrant until the cut-off is 35 per cent. of the stroke instead of 20, whereupon, in this particular case, the normal card becomes equal in size with the card representing an assumed improved gear. The

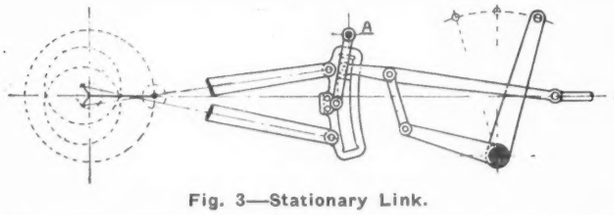


Fig. 3—Stationary Link.

real question, therefore, may generally be stated as follows: Is the improved card at 20 per cent. a better card than the normal card of equal area at 35 per cent. cut-off? Will the former yield a horse-power upon the expenditure of less steam than the latter? It is upon this latter statement that the argument rests. No device which seeks to improve the steam distribution in a locomotive can succeed which does not save steam when compared with devices now in use. In proportion as it saves steam, it both increases the efficiency of the engines and increases their maximum power, for since the boiler capacity is limited, a pound of steam saved is a pound of steam available for additional services.

Turning now to a consideration of the margin upon which those who would improve valve gears have to work, it must be admitted that it is not large. Results have already been quoted (Table 1), which prove that the locomotive with all its wire-drawing, gives a horse-power on less than 24 lbs. of steam per hour. This is near the minimum. From this performance of a simple locomotive having normal valve gear with its narrow port openings and wire-drawing effects, we may turn to the Corliss engine, the action of which is generally accepted by all improvers of locomotive valve gears as a standard of perfection. Such an engine, with its large port opening, its prompt movement of the valves, can in fact be relied upon to give as good a performance as engines having any other type of valve gear operating under similar conditions of speed and pressure. Corliss engines having cylinders which are comparable in size with those of locomotives and which work under a similar range of pressure are, however, not common, and hence, it is not easy to command data for the proposed comparison. Generally simple Corliss engines work under a lower pressure than locomotives. The best performance of which I have been able to find record of a simple Corliss engine exhausting into the atmosphere, is that of an 18 x 48 Harris-Corliss engine, for which the steam consumption was 23.9 lbs. per hour.* The steam pressure supplied this engine was only 96 lbs. by a gage. On the basis given, the engine should, when supplied with steam at 180 lbs., which is the pressure under which the locomotive data were obtained, require less than 23 lbs. of steam per horse-power per hour. Straining the facts applying to the two classes of engines as widely apart as a knowledge of existing data will possibly permit, we may assume that a Corliss engine, if given the advantage of the high steam pressure and high piston speed common in locomotive service may give a horse power hour, or approximately 8 per cent. less on the consumption and 2 lbs. less of steam than the locomotive. This, then, is the margin upon which those who seek to improve the locomotive valve gear must expect to work. While it is well worth attention, it cannot revolutionize practice.

I am aware that this statement is in conflict with the experi-

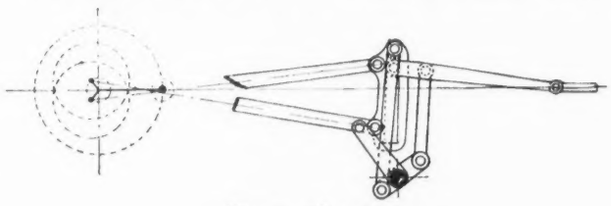


Fig. 4—Allen Link.

ences of many men who, having been interested in special gear, have found them to be 10, 20 and even 30 per cent. more efficient than the link motion they have displaced. A careful examination of such cases, however, will not fail to disclose the fact that the normal gear, which is made the basis of comparison, was either poorly designed, or in poor condition, and hence the results are misleading. Obviously, where two systems are involved, comparison should be based upon the best type which can be selected of each.

VALVE-SETTING.

While somewhat apart from the purpose of my discussion, I cannot refrain from making brief reference to the matter of valve-setting, for which Fig. 2 furnishes a most admirable text. Experience both upon the testing plant and upon the road has shown that in setting valves care should be taken to avoid excessive lead at running cut-offs. Whenever the setting is such as to give a loop in the top of the card such as that which appears in the cards of the left-hand column (Fig. 2), it is safe to conclude that there is too much lead. Its reduction will increase the economy with which the engine will work at the cut-off in question. Experience also has shown that it is profitable so to reduce the lead as to avoid the loop at running cut-offs, even though there is negative lead for the longer valve travels. An examination of Fig. 2 is of interest in this connection. The cards at 15 per cent. cut-off already referred to, present too much lead, but the cut-off in question is really shorter than that at which any locomotive should be operated, and if it be assumed that these cards represent conditions which, if not impracticable, are undesirable, which is the fact, the next column of cards at 20 per cent. cut-off may be accepted as those of shortest cut-off. Here the loop has disappeared and the form of these cards may be accepted as that which attends a satisfactory degree of efficiency. With the valves thus set, it is interesting to note that at the longest cut-off of the series, namely, that of 45 per cent. stroke the lead is insufficient to sharpen the initial corner of the card, which, upon the diagram appears rounded. This, however, should create no concern, since the cards which are here presented, were obtained under conditions which have been proven to be highly efficient.

FOREIGN VALVE-GEARS.

Having now considered the frailties and virtues of the link motion, we may inquire concerning other forms of gears which in foreign countries at least are in common use. In England one occasionally sees the stationary link as shown by Fig. 3, the link hanger of which is suspended from a fixed pin, A, while the reverse shaft is connected with a radius rod which communicates the motion of the link to the valve spindle. A modification of this gear is found

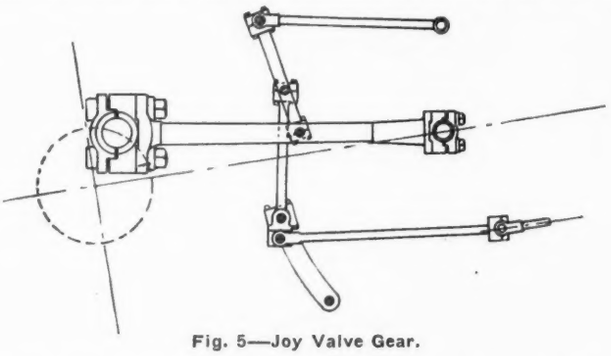


Fig. 5—Joy Valve Gear.

in the straight or Allen link, shown by Fig. 4, in which both the link and the radius rod have connection with the reverse shaft which in reversing causes them to move in opposite directions.

The Joy gear (Fig. 5), which has been, and still is, extensively used in English practice, requires no eccentric, but receives its motion directly from the main rod. The reversal of the engine

*Peabody's Thermodynamics.

and changes in the travel of the valve are, in this gear, accomplished by varying the inclination of the curved guide along which a block is forced to travel with each reciprocation of the main rod. The guide remains stationary, except as acted upon by the reverse lever.

As a last example from foreign practice, is presented the typical gear of Continental Europe, namely, the Walschaert gear (Fig. 6). In this gear, motion is derived from the crosshead and from a single eccentric, or, where the gear is outside of the frame, from a return crank. These motions are so combined by means of a system of connected rods and a link as to give the usual motion to the valve. A radius-rod connecting with the link-block receives motion from the reverse shaft in reversing, and in changing the travel of the valve.

The fact concerning these foreign gears which I most wish to emphasize is, that they all give a motion to the valve which may be represented by a valve ellipse such as that shown by Fig. 1. There are minor differences in the character of the resultant motion which my present purpose will not permit me to discuss, the important fact being that the mechanisms in question are not to be regarded as reform gears. They are not to be contrasted with the Stephenson link motion, but compared with it. They do not exist because they give a better steam distribution than is obtained from the link-motion of this country, and except as may be hereinafter suggested, they are not superior to the gears common in this country. With this understanding of the matter, we may now examine the several gears referred to, and seek to find a reason for their existence, in the conditions under which they are used.

From that which has already been stated, it may be surmised that the Stephenson link-motion as used upon American locomotives, constitutes a convenient and acceptable gear. There are at least four good reasons why this is so, which may be enumerated as follows:

1. The gear gives a satisfactory distribution of steam.

2. Its design readily adapts itself to conditions involving the use of a rocker between the axle and the valve, and the rocker has

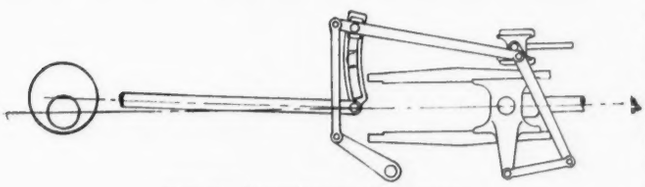


Fig. 6—Walschaert Valve Gear.

until recently been regarded as an essential element in the design of the American locomotive.

3. The accessibility of the forward driving axle and the unoccupied space between the frames in American locomotives as a point of attachment for eccentric, has supplied ideal conditions under which to develop the link motion.

4. Other forms of gear which have been used elsewhere have been thought impracticable in American service because, owing to the small diameter of driving wheels, which, until recently, have prevailed in this country, the mechanism of such gears often extending too near the roadbed for safety.

The stationary link (Fig. 3) has proven attractive to the designers of many English engines, because it involves the use of a single eccentric, room for which is more easily found upon the inside connected engines common to English practice where the greater part of the forward axle is occupied by cranks.

The Allen link responds to conditions similar to those which are met by the stationary link, but is a better design, since by it the lines of motion are kept much nearer the lines of force.

The Joy valve-gear is distinctively English in its design, and in the extent of its use upon locomotives. With the increased size of the inside connected locomotive, the inside crank of the forward axle gradually developed proportions which made it difficult to find room even for a single eccentric.

Confronted with these conditions, the Joy gear naturally makes a strong appeal to the designer. This gear takes its motion from a connecting rod and leaves the forward driving axle to be occupied wholly by the cranks. For locomotive service the Joy gear is perhaps inferior to either of the other motions described, since irregularities in the track materially affect the distribution of steam. For example, when a low joint permits the wheel to drop, the connecting rod partakes of its motion and carries it on to the valve-gear and to the valve.

The Walschaert gear, which is extensively used in Continental Europe, may be either inside or outside of the frames of the engine. In European practice, where inside cylinders have been much employed, it has generally been outside of the frames. Its design makes a strong appeal to the designer who is forced to go outside of the frame with his valve motion. For this reason, its use is likely to increase in American practice. If, as many engineers believe, some form of balanced compound is to gain ascendency in this country, there will be greater difficulty in retaining the valve-gear between frames. As an illustration of this, it is of interest to note that the Mallet compound, built by the American Locomotive Company for the Baltimore & Ohio Railroad, and exhibited at St. Louis, is designed with Walschaert valve gears. The gear is one in which the metal for the parts may be well distributed to transmit the stresses which are brought upon them, and for this reason it may constitute a very stiff gear, though its individual parts are relatively very light. A most admirable type of this gear, with some special adaptation to meet the requirements of the compound principle, is illustrated in the von Borries balanced compound locomotive, which was on exhibition during the summer at St. Louis.

The conclusion to be drawn from the foregoing discussion should not be one of discouragement for those who are interested in improving the locomotive valve gears. In so far as I may have commended forms of gears now common, I have had no wish to imply that better ones may not be devised. The force of my argument is, however, that real and lasting improvement is to be looked for more along mechanical lines than in attempts to improve the character of the motion imparted to the valve. While there is a chance for slight saving in fuel, the real economy which may result from the adoption of a better gear is to be found in its lower maintenance cost, and in the greater certainty of its action, rather than in pounds of coal saved. What is most desired in a valve gear is a mechanism which under the adverse conditions of actual locomotive service, will give to the valve that precision of movement it is designed to have. Along these lines there is ample opportunity to improve the present practice.

Train Dispatchers' Convention.

The 18th Annual Convention of the Train Dispatchers' Association of America opened on Tuesday, June 20, at the Brown Palace Hotel, Denver. The Credentials Committee reported 46 members present. The President's address was then read. The election of new members was the next business in order and the convention balloted upon 43 candidates, electing 40. The report of the Executive Committee was read, congratulating the Association upon its continued prosperity. There is a balance of $373, in addition to railroad bonds to the amount of $2,000, an increase of $360 over the previous year in assets. The net increase in membership during the year was 34, and the total present membership of the Association is 884. The Committee on Topics reported the following five questions:

1. How can forms of orders be shortened or improved, and how much, if any, deviation from prescribed forms may be permitted in the interest of brevity? Give instances or conditions where improvement might be made.

2. Can the use of the "19" order be extended beyond the usual practice, i. e., giving it only to inferior trains? If so, how? Can a safe method be adopted for using it in every case for all trains?

3. What form of dispatchers' transfer do you consider best, and why?

4. Do you favor a printed form for train order books for dispatchers' use? If so, what are the advantages?

5. To what extent may a train crew continue to use orders after having changed their identity, i. e., assumed a train of another number or designation? Consider: First: Kinds of orders: (a) Annulment. (b) "Run late" orders (Form E), (c) Extra with right over other trains (Form G, example 3).

Second: Manner of changing identity: (a) Running a regular train to terminal and returning on another. (b) Running a regular train but change to extra in order to exceed schedule time. (c) From an extra to a work extra, or vice versa. (d) "Short run" extras, i. e., running orders over part of the district only, another order being issued to complete run. (e) From one section number to another.

In response to these questions papers were submitted by Messrs. F. H. Hadley (Pennsylvania), of Media, Pa.; J. W. Cuineen (Lehigh Valley), Auburn, N. Y.; E. R. Gassman (L. S. & M. S), Toledo, O.; T. D. Dillmin (L. S. & M. S.), Youngstown, O.; D. B. Fleming (N. Y. C. & H. R.), Jersey Shore, Pa., and W. J. Choapman (Southern Railway), Greensboro, N. C. Mr. Dillmin's paper will be found in another column.

A paper on Rule 4B, standard code, by Mr. H. A. Dalby, was also read. The Train Rules Committee submitted a number of suggestions for amendment for the standard code covering definitions and the following standard code rules:

Rule 4 (A), 4 (B), 20, 93 and 218, and forms of orders A, B and K. Also a rule providing for the "X" response as a substitute for repetition of the order by the operator at the meeting point, in case of "meet" and "wait" orders.

Two sessions of the convention were fully occupied in discussing these topics and the reports of the Train Rules Committee.

The election of officers resulted in the election of F. X. Meyers (Texas & Pacific), Marshall, Tex, for President; L. H. Phetteplace (N. & W.), Williamson, W. Va., for Vice-President; J. F. Mackie

(re-elected) editor, and Messrs. C. D. Richards, T. D. Dillmin, C. W. Fisher and J. B. Jerome, members of the Executive Committee.

The next meeting will be held at Buffalo, N. Y., in June, 1906.

The convention held three sessions each on Tuesday and Wednesday, and the members devoted the remainder of the week to enjoying the hospitalities of the Colorado railroads, Thursday being occupied in a trip over the new Moffat road, whose present terminus is Arrowhead, at the entrance to the famous Middle Park, which will be traversed by this road in its progress towards Ogden. The unequaled scenery along this route will at some future time undoubtedly form one of the chief attractions of Colorado to tourists. No section of Colorado embraces within such a limited distance the same variety of mountain scenery that is afforded by this road. Friday was devoted to a trip over the Colorado Southern to Silver Plume and return. This trip embraces the famous Georgetown Loop. Saturday was occupied with a trip to Cripple Creek over the Colorado Springs & Cripple Creek District Railway and to Pike's Peak. The convention was one of the most interesting and pleasurable in the entire history of the association.

The Cost of Locomotive Operation.

VII.

BY GEORGE R. HENDERSON.

(Continued from Vol. xxxviii., Page 577.)

WATER TREATMENT.

When locomotives were small and had a comparatively easy time, little attention was paid to the material in the water, but as they became larger and were forced to work more continuously, the trouble increased. In desperation over leaky flues and cracked fire box sheets, the method of introducing soda ash, or carbonate of soda, into the tender, and so to the boiler, became quite general, and is still used at many places. In time, however, it came to be recognized that the boiler of a locomotive was hardly the place to do this work of freeing the water from impurities, as the sludge filled the lower part of the boiler, necessitating very frequent blowing off and washing out, and the more logical method of preparing the water before it was delivered to the tender became popular. There are quite a number of treating plants at present in use; in some the apparatus is patented and in others it is home-made. All, however, depend upon chemical action for their success. The soft scaling waters, containing carbonate of lime or magnesia, held in solution because the water itself is charged with carbonic acid gas, are simply treated with slaked lime, which unites with the free carbonic acid, forming carbonate of lime. This, being insoluble in water free from carbonic acid, settles as a white precipitate, accompanied by the carbonate previously in the water in solution. The clear water is drawn off above the sediment, and thus none of the carbonates get into the boiler, but practically pure water is delivered. As quick lime (from which the slaked lime is made) is a cheap substance, the cost of chemicals for such treatment is small. As one pound of carbonate of lime requires a little more than half a pound of quick lime for its precipitation, we may say roughly, that for each grain of carbonates in a gallon of water, we should need one-tenth pound of lime for treating 1,000 gallons, this referring, of course, to the incrusting carbonates of lime and magnesia. With lime at 50 cents per barrel of 200 pounds, a water containing 40 grains of carbonates of lime and magnesia, would cost but one cent for the necessary amount of quick lime; the cost of labor would depend mostly upon the size of the plant, as a large one would require no more attention, perhaps, than a small one. The hard scaling waters are more costly to treat by six or eight times. Sulphate of magnesia alone, does not form boiler scale, but when present with carbonate of lime, a reaction takes place, and sulphate of lime is formed. When 300 degrees temperature is reached, this is precipitated, making a hard, cement-like coating on the flues and sheets. In order to remove these sulphates from the water before it is supplied to the tender, it is treated with carbonate of soda, or soda ash, as it is commonly called. The chemical reaction produces carbonate of lime and sulphate of soda, so that the carbonate of lime will settle, as before. As one pound of sulphate of lime requires .85 pound of 58 per cent. soda ash for its precipitation, it will require one-eighth of a pound for each 1,000 gallons containing one grain of the sulphate per gallon, and as soda ash is worth about one cent a pound, we could treat only eight grains per gallon for one cent per thousand gallons. The cost of treatment will thus be seen to depend entirely upon the ingredients in the water.

Corroding materials, such as acids and chloride of magnesium, may be neutralized with quicklime or soda ash, chloride of magnesium requiring about the same amount of soda ash as sulphate of lime.

Many of the large railroads in this country have now gone very extensively into water treatment. The Southern Pacific has made, by Mr. Howard Stillman, a very complete organization for this work, and reports are constantly issued on this subject. From some at hand it appears that the cost of chemicals varies from one to five cents per 1,000 gallons. They grade the waters as follows, according to the grains of incrusting matter per gallon:

Good, less than 12 grains per gallon.
Fair, 12 to 20 grains per gallon.
Poor, 20 to 30 grains per gallon.
Bad, over 30 grains per gallon.

Mr. G. M. Davidson, of the Chicago & North-Western, has taken the matter up actively, and states the cost at from 1 to 10 cents per 1,000 gallons. The Union Pacific costs have been stated by Mr. J. B. Berry from one-third cent to 3½ cents per 1,000 gallons for chemicals only. On the Santa Fe, while the majority of waters would need for chemicals, from 1 to 5 cents' worth per 1,000 gallons, some waters ran higher, in one case reaching 21 cents. This latter, however, it was not practicable to treat, and it was abandoned as a water station.

While carbonate waters can be easily and cheaply treated, and a comparatively pure water supplied to the boilers, it is not so with sulphates of lime and magnesia. After the reaction, the carbonate of lime formed, settles to the bottom of the tank, and can be blown off as "sludge," but the sulphate of soda, the soluble result of the chemical change, goes into the boiler and, if in large quantities, or allowed to become concentrated by evaporation, causes foaming. Soluble matter of over 30 grains per gallon will be likely to give trouble on a locomotive, on account of the constant agitation, although 50 or 60 grains can be endured in a stationary boiler. This is illustrated by the analyses before and after treatment of a water from a driven well, in the middle west:

	Grains, per gallon — Before treatment.	After treatment.
Carbonate of lime	24.39	2.26
Carbonate of magnesia	1.18	.88
Sulphate of lime	6.22	...
Sulphate of magnesia	13.33	...
Chloride of sodium	1.21	1.27
Sulphate of soda	5.58	26.32
Incrusting solids	46.88	3.54
Soluble salts	6.79	27.81

Here we notice after treatment, an increase of 21 grains per gallon in the soluble salts—slightly greater than the sulphates of lime and magnesia (which total 19½ grains in the raw water), but the carbonates have practically disappeared. If we take a water such as the following, which is found in the southeastern part of Colorado, we are sure to have trouble after treatment:

	Per gallon.		Per gallon.
Carbonate of lime	10.67 grains.	Sulphate of magnesia	13.52 grains.
Sulphate of lime	19.01 "	Sulphate of soda	17.82 "
Carbonate of magnesia	1.13 "	Chloride of sodium	1.17 "

This water untreated, will form a hard scale on account of the sulphate of lime; if treated with lime and soda ash, the carbonates can be settled and drawn off, but there will remain in solution from the sulphates of lime and magnesia about 33 grains of sulphate of soda, in addition to the 17.82 grains already in the water, making a total of about 50 grains, which would certainly give trouble from foaming.

The Southern Pacific does not think it advisable to treat water if the soluble alkalies exceed thirty grain per gallon (whether naturally contained or introduced by chemical reaction), as troubles from foaming in road service with losses included may largely exceed the cost of boiler repairs due to incrustation. As an example of this, one of their California waters which analyzes as follows:

	Per gallon.		Per gallon.
Carbonate of lime	12.42 grains.	Sulphate of magnesia	10.67 grains.
Sulphate of lime	2.39 "	Sulphate of soda	11.32 "
Carbonate of magnesia	2.97 "	Chloride of sodium	9.62 "

is considered by them as untreatable, for the reasons given above, viz., that if the sulphates of lime and magnesia were changed to carbonates and sulphate of soda, the soluble salts as a total would amount to over 30 grains per gallon. Another California water contains but 12 grains of carbonates and practically no incrusting sulphates, but has 45 grains of salt to the gallon, and is considered untreatable also. Under such cases, it seems that nothing but distillation will get rid of the matter in solution. Tannic acid and boiler compounds have been tried, but they are only partly successful.

DISTILLATION.

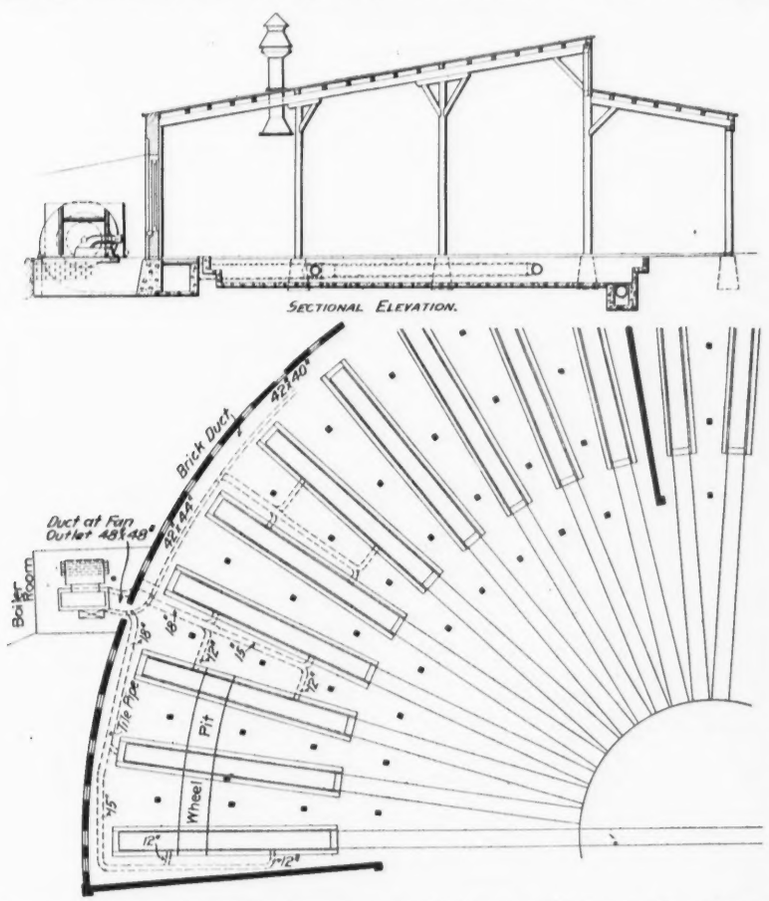
Under ordinary conditions, the cost of this method of purification would be prohibitive, as can be plainly seen by a few simple calculations. Good coal should evaporate 10 lbs. of water for each pound burned, from and at 212 deg. Fah., at atmospheric pressure. 1,000 gallons, weighing about 8,000 lbs., would therefore require 800 lbs. of coal, and at $1.00 a ton, this would mean 40 cents a thousand gallons for fuel alone. Multiple effect stills, however, can be procured, which will reduce the fuel consumption. The Yargan apparatus will distil water at the rate of about 40 lbs. per pound of coal, and the Goss still will double this. Under these latter conditions, 1,000 gallons of water would require but $\frac{8000}{80} = 100$ lbs. of coal, and at $1.00 per ton, the cost for fuel would be 5 cents. As in the treating plants, the labor would depend upon the size of the plant.

and as there are many railroads that obtain their coal at less than $1.00 a ton, it is apparent that conditions may exist where the cost of distillation will not exceed that for chemical treatment, and the latter is not available for foaming waters. Such a still was experimented with in the California desert on water containing over 350 grains of soluble alkali per gallon, and this was readily reduced to a workable strength, that is, less than 30 grains per gallon. At this point it was customary to haul water nearly 60 miles, making it cost fully 30 cents per thousand gallons. Fuel could be supplied at this point at the rate of $1.00 a ton, and allowing for labor and repairs, the cost of distilled water would run about 13 cents per 1,000 gallons, a reduction of 17 cents under the cost by hauling in trains. There are many places in the west where the combination of cheap fuel and foaming water naturally suggests this method of purification, but for the ordinary carbonates of lime and magnesia, the chemical treatment is the proper course to pursue. The cost in any case, can be estimated as above outlined.

(To be continued.)

Heating and Ventilation System for a 20-Stall Roundhouse.

The accompanying illustration clearly shows the heating and ventilating equipment as installed in the 20-stall roundhouse of the N. Y., O. & W. R. R. at Middletown, N. Y. The equipment as shown consists of a Sturtevant blast wheel 7 ft. in diameter by 4 ft. in width. This is inclosed in a ¾-in. steel plate housing, the lower portion of which extends beneath the floor and contains the outlet through which the air is discharged into an underground duct. The



Heating and Ventilating Equipment as Applied to the Middletown Roundhouse of the N. Y., O. & W. R. R.

fan is driven by a 7 in. x 10½ in. direct-connected engine, and draws the air through a Sturtevant heater containing 6,900 ft. of 1-in. pipe. This equipment was installed to maintain a minimum temperature of 65 deg. in the building with a temperature of zero outside. It is stated that during the last winter the steam was furnished from an old engine located outside of the roundhouse, as the new boiler could not be arranged and put in place at the time. The figures upon which the apparatus operated last winter are therefore subject to change under altered conditions of equipment. It is stated that with a steam pressure of 130 lbs. on the old engine and with nights during the winter when the thermometer was from 5 deg. to 20 deg. below zero, engines came into the house completely covered with snow and were thawed out in from one to two hours. It would have taken from five to six hours to have thawed these engines out in the old roundhouse, which was equipped with steam pipes in the pits. Steam pipes in the pit are also more or less undesirable, as the men are liable to be burned and the pipes are apt to be injured by heavy castings or other material falling on them. For the above information we are indebted to Mr. C. E. Knickerbocker, Engr. M. of W., and others.

Car Accountants' Annual Meeting.

The second annual meeting of the Association of Transportation and Car Accounting Officers was held at the King Edward Hotel, Toronto, Canada, June 20 and 21. The attendance of members was all that could be desired, very few being absent. It will be recalled that this organization was started under the new name a year ago, at the twenty-ninth annual convention of the car accountants, and the eleventh of the Transportation Association, held at Washington when both these united to form one strong body; the present gathering, therefore, may also be rightly described as the thirtieth successive annual meeting of the society.

The report of the executive committee showed 168 roads had joined the organization—holding 193 active memberships, with a road mileage of 200,259 miles, and owning 1,811,917 cars; there were 84 associate members—20 representing car service bureaus, and 64 fast freight and private car lines; there are also 39 honorary members. The treasurer reported all accounts paid and a balance on hand.

No amendments were suggested to the code of per diem rules, the various points discussed under this head having relation only to the proper application and interpretation of the rules. In the operation of Rules 1, 2 and 9, it was stated that considerable amounts of per diem have been found uncollectible, or have to be held outstanding from month to month, owing to differences or errors occurring in reported dates of car movement between delivering and receiving roads; and that instead of taking prompt action to determine which of the two is responsible for payment, these roads usually throw upon the distant owning road the almost hopeless task of settling the quarrel, and of obtaining the per diem justly due. After discussion, the question was referred to the per diem committee for recommendation, the general opinion being that the delivering road should be held responsible for adjusting all such cases with the receiving road, and of reporting the result to the car owner.

The penalty rule (3) having been rendered inoperative in many cases, through errors in reports of movement of cars, the following resolution was brought forward and referred to the committee for action:

"That any road failing to report to the owner the delivery of a car to connecting road, or failing to give correct information in reporting delivery of a car, shall be held responsible to the owner for all penalty which could have been obtained had proper information been supplied."

Differences of opinion having developed as to the meaning of the reconsigning clause in Rule 6, as to what constitutes a reconsignment of a car at destination to a non-per diem road—for unloading, especially in cases where such road is not mentioned in the way bill—the per diem committee was authorized to obtain particulars of a case, and to submit it to the arbitration committee of the American Railway Association for decision.

The car service committee, in emphasizing the necessity for improved methods for the economical movement of L. C. L. freight, referred—as an object lesson—to the clearing platform and transfer facilities for consolidation of loads, installed at Elizabethport on the Central of New Jersey, describing it in detail; the record of one month's work was 4,645 car loads received, and 4,430 forwarded, a saving of 215 cars or 4.6 per cent., the average loading having been brought up to 9,400 lbs. per car.

The representative of a western road also gave the result of adopting similar methods at various points, supplemented by meetings of agents for instruction; the movement of 28,000 cars having been saved in ten months' operations, greatly increasing the average load per car, and reducing the cost of movement, as well as releasing 28,000 cars for other business.

The committee's recommendations on the following subjects were adopted:

1. When a car is offered for return trip to a road over which it moved in the opposite direction one year or more previously, the

offering road shall at the same time give data of the previous movement.

2. For the purpose of establishing uniform practice in the handling of embargo notices, the transportation officer in charge of distribution of equipment as shown in columns of *The Official Railway Equipment Register*, shall be designated as the proper party to issue, and with whom to place embargo notices.

3. Baggage cars with theatrical scenery.—It is the sense of this Association that it is desirable that a card way-bill or car ticket should accompany each car of passenger equipment moved over the road in other than regular service, whether loaded or empty.

The committee on office methods and accounting, reported progress on several important subjects, as under:

1. Measures for preventing duplication of initials and numbers in marking freight equipment on the various roads.

2. The tracing of car load shipments in interline business.

3. Measures for securing accurate reports of cars placed on industrial tracks, accessible to two or more per diem roads.

4. The formulation of a concise method for computing the average miles run per car per day on home lines, the adoption of which will secure uniformity in these statistics on all roads, for comparative purposes.

In order that due consideration may be given to subjects immediately connected with transportation, it was revolved that a committee on "transportation topics" be appointed, to which all matters under that head shall be referred.

On the subject of car demurrage and car service associations, the movement for antagonistic legislation in the shape of extended time and reciprocal demurrage, was touched upon, and the fact was stated that such legislation had been enacted in three states. It was the general view that such action would injure the users of cars more than the owners, as the demurrage rules were more protective of the interests of the traders than of the railroads; and if users of cars were allowed more time to load and unload, the effect would be to reduce the number of cars available for load, and for the trade of the country. In the matter of car supply the interests of both railroad and trade were identical, also the same principle obtained as regards the prompt movement of loaded cars, so that legislation to compel the roads to do what they are bending their best energies to accomplish, seems unnecessary and anomalous.

Mr. A. J. Elliott, of the Peoria Car Service Association, addressed the convention by request, on this subject, and his remarks were enthusiastically endorsed.

The election of officers resulted as follows:

For President, H. L. Hunter, M., St. P. & S. S. M. Ry., Minneapolis, Minn.

For First Vice-President, D. E. Spangler, Norfolk & Western Ry., Roanoke, Va.

For Second Vice-President, T. S. Bell, Pennsylvania R. R., Philadelphia, Pa.

For Secretary, G. P. Conard, Official Ry. Equipment Register, New York.

For Treasurer, F. M. Luce, C. & N. W. Ry., Chicago, Ill.

For Executive Committee, I. N. Seale, Southern Ry., Washington, D. C.; H. G. Sleight, Vandalia Ry., Terre Haute, Ind.

New Orleans was chosen as the place of the semi-annual meeting in November next, and Denver for the annual meeting in May or June, 1906.

The Vienna "rapid transit" city railroad is not yet a mine of gold, though it is several years old. In 1904 its gross earnings were $1,031,608 and its working expenses $1,185,796, which is $109,400 more than the year before. When the lines were built the city was almost like New York before the first elevated railroad; but about the time it was finished the street railroads were transformed into electric lines, and served better than the rapid transit lines for most people. The number of passengers on the latter was 6 per cent. less in 1904 than in 1903.

Some Causes of Failure of Rails in Service.*

BY ROBERT JOB,
Chemist, Philadelphia & Reading Railway Co.

For a number of years a careful study of causes of rail failures has been made by the Philadelphia & Reading Railway. The method followed has been in the case of each failure to forward a portion of the rail showing the defective condition to the test department with a form giving information regarding the manufacture and service of the rail. An investigation then followed to determine the cause of the failure. In a general way it may be said that when failure occurs owing to fracture, excessively rapid rate of wear under given conditions, or crushing down in track, the poor service is generally due to one or more of the following causes, viz.: (1) Pipes in the steel; (2) presence of a considerable proportion of blow-holes; (3) excessive segregation; (4) coarse granular structure; (5) rough handling. In the first case the defect is readily shown by the appearance of the fractured end with its unwelded surfaces, and upon buffing off a section of the rail, the extent of the pipe is generally clearly shown, even without etching, as in Fig. 1. In such case the steel is in a seamy condition, and the layers readily split apart or crush down upon comparatively slight pressure, and indication of the unsoundness is usually given after a very short service. This general type is caused by failure at the mill to crop ingots down to sound steel, and such a rail is nearly always derived from metal from the top of an ingot, and almost invariably fails when tested under the drop test. When the mill inspection is watched closely and when it is seen that the test butt for the drop test is always taken from the top of the ingot, failures due to such pipes are relatively rare. A defect of this character is one of the most dangerous which can be present, since it is liable to result in sudden crushing under light pressure, and consequently it should be guarded against most carefully at the inspection.

The second cause of failure, viz., presence of considerable proportion of blowholes in the steel is probably the most common defect under present mill practice, and the one which causes the largest number of failures in service to-day.

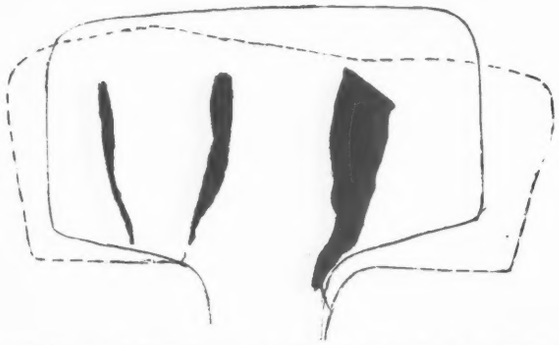


Fig. 3—Contour of Rail Shown in Fig. 4 After Service of Five Months.

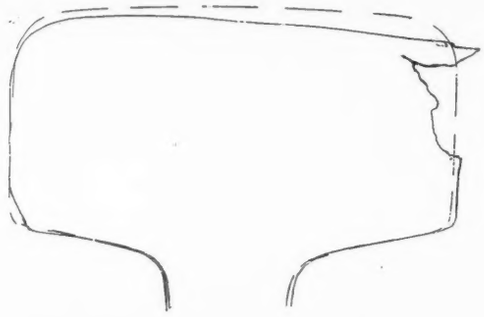


Fig. 5—Contour of Fig. 6 After Two Months' Service.

Such rails usually do not fracture after a very short service unless the extent of the blowholes is very pronounced, but the defects are generally noticed by the gradual mashing down of portions of the rail, accompanied generally by flowing over at the sides of the head, and the track men are apt to complain that the rail in question is "too soft," or that it has numerous "soft spots." Analysis proves, however, that the metal is not softer than that in other rails adjoining the defective one, but upon polishing and etching the section lightly with iodine or other medium it will be found that the steel is unsound, or in other words, that blowholes, slag and other foreign matter have prevented thorough welding of the steel and have resulted in a number of seams which break up the solidity of the metal and permit a slipping apart of the unwelded surfaces under moderate pressure, causing final fracture or crushing. In some cases this condition is caused by presence of slag and of oxides in the steel, but in the greater number of instances it is simply due to blowholes, and relatively little slag or oxide is present.

Fig. 2 represents the heel of a wing rail of a frog, of the following analysis:

Carbon	0.63	Sulphur	0.078
Phosphorus	.137	Manganese	.874

This rail crushed down in service upon another road into the condition shown, in less than five weeks. Figures 3 and 4 represent a batch of rails which mashed down in a few months upon another road to the contour represented by the dotted line. The unbroken line represents the template, and the large black areas indicate holes in the steel which were formed by the elongation of the metal upon the top of the rail when the failure began. When this section was polished there was no indication of an actual pipe, but upon light etching the cause of the weakness is very evident, showing that the

*From a paper read at the Atlantic City meeting of The American Society for Testing Materials, June 29-July 1, 1905.

steel is so thoroughly unsound and porous that rapid crushing was possible.

The composition of this rail was:

Carbon	0.82	Manganese	0.88
Phosphorus	.102	Sulphur.	.053

and the heat average was:

Carbon	0.59	Sulphur.	0.074
Phosphorus	.075	Manganese	1.06

It is thus seen that a marked segregation was present as well as great unsoundness, and it is evident that the cropping at the mill had been insufficient to get to sound and reasonably homogeneous metal. These rails were furnished under the mill's own specifications and guarantee.

Fig. 1—Pipe in Steel. Section Polished, But Not Etched.

Fig. 2—Wing-Rail, Unsound Steel. Service Five Weeks.

Fig. 4—Unsound Steel, Five Months' Service.

The tendency of some rails to flow over and form a "lip" has been referred to and this frequently is attributed to mere softness of the steel. Our experience has been that a rail with carbon as low as even 0.33 per cent. will not flow over under exceedingly heavy traffic, provided sound steel is present, with granular form fine enough to render the metal tough and strong, and in every instance of flowing over or of breaking down of the side or corner of the head, we have found presence of blowholes or other unsoundness near the surface or corners of the head of the rail, generally within one-eighth or one-quarter of an inch of the surface, whereas in the cases in which the rails have sustained long and heavy traffic we have found comparative freedom from such defects. A case of this kind which was investigated a couple of years ago will illustrate the point. A number of rails from a single rolling had mashed down in track after two months' wear to the general form represented by Fig. 5, the broken line representing the template. These defective rails were upon curves and upon tangent, and were from various heats throughout the rolling, but rails from the same heats and immediately adjoining the defective rails were unaffected by the traffic.

It was found that composition had nothing to do with the failures, but upon polishing and etching the sections we found in the cases in which flowing and splitting occurred that the steel was unsound, as indicated in Fig. 6, while the rails adjoining were in good condition were of sound steel, as indicated in Fig. 7. We have also investigated a considerable number of rails to determine whether or not the form of section exerted an influence upon the tendency to crush in service, and it has been clearly proved that ability to withstand crushing under heavy service is due not so much to any particular form of section as to the relative freedom from unsoundness in the metal. In connection with this question an examination was made about a year ago upon a lot of rails which were removed from main track and relaid in branch lines. The section had a rather deep head with contour approximating that of a wheel flange. Practically no flowing and no crushing was found in these rails after 15 years' service, while a number of rails of the A. S. C. E. section laid in adjoining parts of the same track had crushed and otherwise failed in a very few years. The composition of the different lots showed comparatively little variation, but in the case of the rails which crushed in service we invariably found unsoundness, of the general type indicated by Fig. 6, whereas in the good rails the steel was practically sound within ½ in. of the surface of the top and sides of the head. In other words, the good service was due mainly to the greater care exercised in the manufacture of the earlier rails and their consequent relative freedom from unsoundness.

Up to this point we have made little mention of granular structure of the metal, and it may be inferred that this has little influence upon the permanency of the rail in track. On the contrary we have reason to regard a uniform fine granular structure of high importance both in reducing rate of wear and in cutting down liability of fracture, but it is an unfortunate fact that the very best of steel as regards granular form or composition may be completely and quickly ruined, from the standpoint of efficiency in track, or in other words, as to its value as a rail, by failure in manufacture to ensure reasonable freedom from unsoundness. This to our mind is an integral point in the manufacture of rails, for if any material degree of unsoundness exists in the rail within a distance, say, of ¼ or ½ in. from the head or sides, and more particularly near the upper corners, unsatisfactory service under heavy traffic is almost certain to result regardless of the composition or method of rolling. Such at least has been our invariable experience. As to injurious segregation, we find that relatively few failures in track are due to this condition. If ingots are not properly cropped, or if they are allowed to remain in the furnace with the interior of the ingot in

Fig. 6—Unsound Steel, Service Two Months. Crushed Down as Shown in Fig. 5.

Fig. 7—Sound Steel, Service Two Months. Rail Next in Track to Fig. 6.

Fig. 8—Segregated Rail. Broke Under Drop Test.

a liquid condition for an excessive time, segregation, of course, results, and if the test butt from each heat is taken, as should invariably be done, from the top of the ingot, badly segregated rails will fail, and consequently under such conditions careful guarding against segregation is as much to the interest of the manufacturer as to that of the consumer. Fig. 8 represents one such rail which failed under the drop test, and the extent of the segregation is shown by the fact that the proportion of carbon at the outside averaged 0.49 per cent., while at the center of head borings taken with a ¼ in. drill averaged 0.76 per cent.

Also it will be noted that blowholes extend all along the top of the head. Such cases as this are, however, rare.

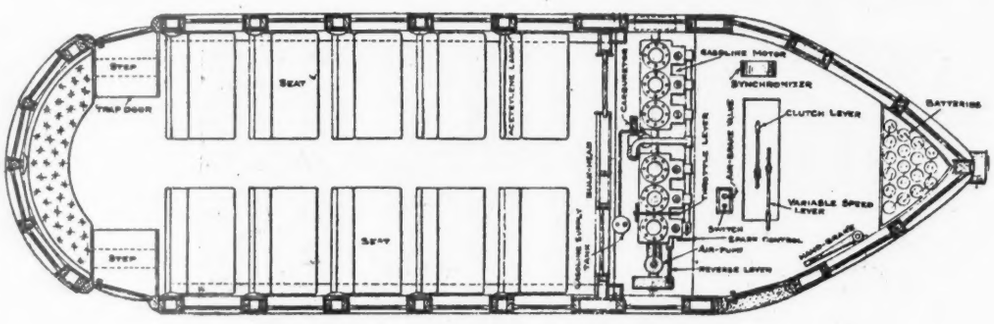
Under "failures due to rough handling" we have found a considerable number from time to time. The initial fracture may, of course, occur either at the mill at straightening presses or in loading into high side cars and letting fall upon other rails 5 ft. or more below, or in letting the rails fall from the loader 6 or 7 ft. upon the ground, and the same thing, of course, may occur after receipt of the rails in unloading unless they are skidded out or otherwise gotten to the ground without any considerable shock. Careful inspection will remedy this condition. A fracture of this type is characteristic. It begins generally across the base of the rail and extends up a short distance into the web, then it works along the web sometimes for a distance of 6 ft. or more, with the face of the fracture in a plane at right angles to a vertical line down through the rail, and the steel finally snaps off up through the head. A fracture due to this cause can generally be identified at a glance and can be distinguished from a fracture caused by pipes, since the latter extend with the unwelded faces more or less parallel with the contour of the rail. To sum up, the results of our investigation indicate that the greater part of the difficulty which occurs to-day with rails under heavy traffic is due to unsound condition of the steel, a condition which existed in comparatively slight degree in the earlier rails. There has been a marked improvement in practice at some of the mills over that generally prevalent a decade or two ago, and this has resulted at such mills in producing a much finer granular form throughout the section and hence a tougher and better wearing rail if only the metal were sound, but unfortunately in the essential element of soundness of the steel there has been direct retrogression, making it appear that the main attention in the manufacture has been fixed upon quantity and not quality of the output.

The Union Pacific Gasolene Motor Car.

Union Pacific gasolene motor car No. 1 was described in the *Railroad Gazette* March 10th. The road has issued a pamphlet concerning this car showing a floor diagram, which is reproduced herewith, giving the following information not contained in the description above mentioned.

The motive power is a six-cylinder gasolene engine of 100 h.p. The cylinders are 8 in. x 10 in., of the upright type, placed at right angles to the center line of the car. The six cylinders are arranged and connected up in opposed sets of three each, resulting in three power-giving pulsations at each revolution of the crank-shaft.

The engine speed has a wide range of control, thus affording great economy under variation of load. A synchronizer facilitates and simplifies the changing of speeds. A reverse throttle and spark levers are all conveniently located and in easy reach of the operator. Immediately in front of him is the air-brake valve lever and the emergency spark cut-out, which enable the operator to stop the engine and apply the full brake power in less than half a second. Spark current is furnished by eight cells of battery, with a "make and break" spark device.



Plan of Union Pacific Gasolene Motor Car.

The clutches and controlling devices are all mechanical and of the simplest design. Special effort has been made to do away with the complicated machinery ordinarily used in utilizing gasolene power for propelling cars of this kind. By means of a special chain, the engine crank shaft drives direct on to the driving axle.

The car is intended for service on 4 per cent. grades, with frequent stops, and is therefore at present geared to a maximum speed of about 35 m. p. h., but with slight changes, if desired, it could be very easily speeded to 60 m. p. h. The acceleration of the car from standstill to 300 f. p. m. is superior to any electric car of the same horse-power. The acceleration for the first 50 ft. is much slower than the electric car (there is no uncomfortable jerk in starting); from 100 ft. on, however, the acceleration is very rapid. On a level or ½ of one per cent. grade the car starts readily on high speed, direct connected, without the use of gears; although on anything over a ½ of one per cent. grade, or with a heavy trailer, it is necessary to use the gear speeds.

The car is easily controlled by one operator and can be stopped and backed up at will, although it is designed to run in one direction. The vibration and noise of the engine have been almost entirely eliminated; in fact, when the car is in motion neither of these can be distinguished. The exhaust of the engine is destroyed in a muffler, the burnt gases escaping at the rear of the car without inconvenience from same.

The car was completed and turned out of the shops during the last week in March, 1905. Before being tested in actual road service it was operated and thoroughly broken in around the Omaha shops and vicinity. During these tests it was coupled to two passenger cars —a standard mail car weighing 52,100 lbs. and a standard coach weighing 60,000 lbs. These cars were successfully started and accelerated, both on a descending grade and on a 1-3 of one per cent. ascending grade, the motor thus starting a total load of 152,100 lbs.

Pulling the standard mail car weighing 52,100 lbs., a trip was made to South Omaha and return. This is up a 1.6 per cent. grade, which was ascended at the rate of 11 m. p. h., the total load pulled being 94,000 lbs. In another test the motor car successfully ascended a sharp grade of 7.8 per cent., or about 400 ft. to the mile, the car being stopped and started repeatedly on the grade.

Itinerary of Runs.—On April 2, 1905, the car was given its initial long distance run. Leaving Omaha at 10 A. M., the run was made west to Valley on the main line of the Union Pacific, a distance of 34.8 miles, and the performance of the car was most satisfactory, especially on the return trip, when the schedule for passenger trains was easily maintained.

April 10th a second test trip to Valley and return was made, the entire run—both eastbound and westbound—being practically made on high speed.

April 16th the car was sent to Grand Island, Neb., and made the entire run of 154 miles in a most satisfactory manner.

April 17th to 22nd, inclusive, the motor car was in regular service on the branch line between Grand Island and St. Paul, Neb., making two round trips, or 89 miles, each day.

April 23rd, the car made the run from Grand Island to North Platte, a distance of 137 miles.

April 24th the run was made from North Platte to Denver, 278 miles, without delay other than meeting trains, delays for orders, etc.

April 26th car made a trip from Denver to Brighton and return, distance 42 miles.

April 27th to 29th, the car was in regular service between Denver and Greeley, making one round trip of 107 miles each day.

April 30th the car ran from Denver, Col., to Laramie, Wyo., distance 164 miles. Leaving Cheyenne, the ascent of Sherman Hill, the summit of the Rocky Mountains, was made, the 27 miles of steep grade being accomplished without difficulty.

May 1st the car left Laramie for Salt Lake City. It arrived at Salt Lake City on the morning of May 4th. Since leaving Omaha April 16th it has made, entirely under its own power, a distance of 2,095 miles, and the performance of the car has been most satisfactory in every respect. May 19th it arrived at Portland, Ore., its destination, to go into regular service.

It should be stated that the car has required but slight running repairs and has not been out of commission since starting on its journey.

Certain members of councils of departments in France, and also corresponding officials of arrondissements, which are sub-divisions of departments, intimated to the cabinet that it would be well if they were provided with free passes. Their request was denied; it was looked upon as the thin edge of a wedge.

New Chief Engineer for Panama.

Mr. John F. Stevens has been appointed Chief Engineer of the Panama Canal, succeeding Mr. John F. Wallace. Mr. Stevens had been selected by the government as Government Railway Expert in the service of the Philippine Commission, under whose supervision about 1,000 miles of railroads in the Philippines were to be built with government aid. He was to have accompanied Secretary Taft on his trip recently begun to the Philippines. Mr. Stevens was born at Gardiner, Me., April 25, 1853. From 1875 to 1876 he was Assistant Engineer of the city of Minneapolis. In the latter year he took up railroad work and was Assistant Engineer on the Sabine Pass & Northwestern, the Denver & Rio Grande, the Chicago, Milwaukee & St. Paul, the Canadian Pacific, the Duluth, South Shore & Atlantic, and the Spokane Falls & Northern. He was appointed Principal Assistant Engineer of the Great Northern in 1890, and in 1895 was promoted to be Chief Engineer of that company. While in charge of the location and building of the western end of the Great Northern, he was personally engaged in engineering work of the most pioneer sort, necessitating long and dangerous trips into the mountain wildernesses. Stevens Pass, in the Cascade Mountains, was named after him. Mr. Stevens also laid out the famous "Switchback," rebuilt important sections of the road in Dakota, Montana and eastern Washington, and built the Cascade tunnel, 2½ miles long. In March, 1903, Mr. Stevens was appointed Chief Engineer of the Chicago, Rock Island & Pacific, and a few months later was elected Fourth Vice-President. In 1904 he was again promoted from Fourth-Vice-President to succeed Mr. Mather, now General Counsel and Chairman of the executive committee, as Second Vice-President. His record is clearly that of a successful engineer and manager, and there is every hope that under his leadership the work on the canal will be successfully carried on. Mr. Stevens's salary is to be $30,000, and it is reported that one of the terms on which he was appointed to the position was a pledge that he would stay in the position under all reasonable circumstances. In the official announcement of his appointment, Secretary Taft stated that the duties of Chief Engineer especially related to the practical work of construction and operation of the canal, and it was for this definite service that Mr. Stevens was selected. The technical plans for the waterway are to be determined by the Commission as a body in conjunction with the Advisory Board of Engineers recently appointed by the President. The plans thus decided from time to time will be executed on the Isthmus by the Chief Engineer. The government believes that the canal work will be more actively prosecuted under this arrangement, by which the Chief Engineer confines himself to the actual work on the Isthmus.

John F. Stevens.

Using "19" Orders for all Trains.*

On the Franklin Division of the L. S. & M. S. (single track line) trains are being operated by using the "19" order in all cases for both the superior and inferior trains, with perfect safety. The operator receiving the order displays the stop signal as per Rule 221-B (Standard Code) and delivers the order with a clearance card.

When an operator has orders or clearance cards to deliver to a train which it is not desired or necessary to have stop, he leaves his train order signal in the stop position, and when the train is approaching he goes out upon the track and gives the engineman a "Proceed" hand signal, using a white flag by day and a white light by night. The engineman will then approach and pass the operator at such a rate of speed as to enable him to hand on (by use of the hoop) the orders and cards to both the engineman and conductor. When delivering orders, the operator must note plainly by figure, upon the last order received, the total number of orders for delivery to the train. Conductors and enginemen use the number as a check to know that they receive all orders for them. In case the engineman or conductor should muff the orders, or if there is anything wrong with an order, they must stop the train and must not proceed until the orders have been received and understood.

We also use the middle order.

By using the "19" order for all trains, the dispatcher can handle a greater number of trains on his division and do better work, than he can by using the "31" order, and I consider it can be done with perfect safety. The "19" order can be used as a hold order, the same as a "31" order, by using the X response. In handling trains by "31" order, a despatcher will usually place the orders for a train at a watering station or some other favorable place, where trains can start without trouble, and thus a train will sometimes receive several orders at one station. It is not well for trainmen to receive too many orders at one time. Train orders should be as short as possible. Sending a long or complicated order, or putting orders in the hands of the trainmen two or three hours before they are fulfilled is apt to cause misunderstanding and to lead to orders being overlooked. By using the "19" order the despatcher can place the order for the superior train one or two stations in advance of the meeting point, and deliver it without stopping the train. The order is then kept in mind by the trainman, and at the same time the train is not being delayed waiting for the conductor to walk 60 to 100 car lengths to sign orders, and you do not have to run the chance of enginemen breaking a knuckle or pulling out a draw bar while starting a 3,500 or 4,500 ton train.

*A paper by T. D. Dillmin, of the Lake Shore & Michigan Southern Ry., Youngstown, Ohio., presented at the 18th Annual Convention of the Train Dispatchers' Association, at Denver, June 20.

American Society for Testing Materials.

The eighth annual meeting of this society was held in Atlantic City, June 29 to July 1. About 200 members attended. The society now has 677 members, an increase of 177 members over the number reported at the last meeting. The Secretary said that he hoped the society would continue to increase and that by the next meeting he would be able to announce its membership at one thousand. The following officers held over for another year: President, Charles B. Dudley; Vice-President, R. W. Lesley; Secretary and Treasurer, Edgar Marburg, University of Pennsylvania, Philadelphia. W. A. Boswick and Mr. McLeod were elected members of the Executive Committee. Aside from a number of committee reports, papers were read as follows: Address by the President, Charles B. Dudley, on The Testing Engineer; A Course of Laboratory Instruction in Testing Materials, W. K. Hatt; A Course in Properties of Materials, G. L. Christensen; Plan and Scope of the Proposed Investigation of Structural Materials Under the Auspices of the U. S. Geological Survey, J. A. Holmes and Richard L. Humphrey; The Collective Portland Cement Exhibition and the Results of the Tests Made at the World's Fair, St. Louis, Richard L. Humphrey; Normal Consistency Tests of Neat Cement, Topical Discussion introduced by R. S. Greenman; Economical Mold for Forming Compressive Test Pieces for Concrete, Clifford Richardson and C. N. Forrest; Slow-Pulling, Early-stage Rotary Portland Cement vs. the Ordinary Early-strength-developing Product, W. A. Aiken; British Standard Specifications for Cement, with Introduction by R. W. Lesley; Impact Tests of Asphalt Paving Mixtures, Clifford Richardson and C. N. Forrest; Standard Specifications for Preservative Coatings for Steel, Topical Discussion by C. B. Dudley, Robert Job, A. H. Sabin, Maximilian Toch and Cyril de Wyrall; Proper Methods in Conducting Painting Tests, G. W. Thompson; Protection of Iron and Steel Structures by Means of Paper and Paint, Louis H. Barker; What is the Best Method of Painting Steel Cars? Topical Discussion introduced by F. P. Cheesman, G. W. Thompson and S. M. Evans; Some Causes of Failure of Rails in Service, Robert Job; Influence of Methods of Piling Staybolt Iron on Vibratory Tests, H. V. Wille; A Preliminary Report on Tests of Nickel Steel and

Carbon Steel Under Combined Stresses, E. L. Hancock; A Comparison of Standard Methods of Testing Cast Iron, Richard Moldenke; Hard Cast Iron: The Theory of One of its Causes, Henry Souther; The Thermite Process in American Practice, E. Stuetz; A Large Hydraulic Testing Machine for Uniform Loads, Robert A. Cummings; Specifications for Cotton Tapes for Electrical Purposes, R. D. DeWolf; Rail Sections as Engineering Structures, P. H. Dudley.

Papers in the above list which are of particular interest to railroad men will be printed in whole or in part in future issues of the *Railroad Gazette*.

The Use of Superheated Steam on Locomotives.*

(Continued from Vol. xxxviii., Page 757.)

RESULTS.

The results obtained from superheating appear invariably to have shown a decided economy. Starting with the instance previously referred to as reported by Trevethick, in which an economy of 30 per cent. was obtained with an unknown degree of superheat, but in which 7 per cent. of the total coal burned was used in the superheater, all of the various tests show a remarkable agreement in results. A short statement of a number of experiments, which follows, is interesting as showing a general agreement among a number of investigators:

Hirn, in a report issued in 1857, describing the results of various experiments carried out by himself on a simple engine working at a pressure of 55 lbs., obtained economies of from 20 to 45 per cent. with steam superheated to from 410 deg. to 490 deg.

John Penn, before the Institute of Mechanical Engineers in 1859, reports on a condensing marine engine on the S. S. "Valetta," 260 h.p., boiler pressure 20 lbs., boiler heating surface 4950 sq. ft., superheater forty-four 2-in. tubes in smoke-box, superheating surface 720 sq. ft., superheat 100 deg. F. Saving, 20 per cent. in fuel.

John Ryder, in a paper before the Institute of Mechanical Engineers, 1860, reports on a condensing marine engine on the S. S. "Buster," boiler pressure 10 lbs., superheater, two return-pipes over fire, superheat 144 deg. Saving, 25 per cent. in fuel.

Bryan Donkin, article in *Engineering*, 1891, reports on a simple non-condensing horizontal engine, boiler pressure 50 lbs., revolutions 220, superheat 50 deg. F., saving, 15 to 27 per cent., dependent on cut-off (probably water consumption). Higher temperature of cylinder walls noted.

W. H. Patchell, paper before Institute of Mechanical Engineers in 1896, reports on a horizontal tandem compound condensing engine, 300 h.p., cylinders 18 in. and 36 by 48 in., boiler pressure 100 lbs., superheater, Hick, Hargreaves & Co., superheat 42 deg. to 55 deg., economy in water, 9.6 per cent.; in coal, 19 per cent. (indicates part gain due to more efficient boiler results, water evaporated per pound coal, increase 13 per cent).

Other tests on Lancashire boilers show a very similar result, considerable gain being shown in water evaporated per pound of coal.

There are any number of similar instances in stationary practice, and it is significant that such decided gains have invariably been obtained from simple non-condensing engines, and this fact would lead to the expectation of decided benefits in locomotive work.

The tests of the first locomotive equipped, Hanover No. 74, which were reported by Mr. Garbe in his paper of 1902, showed excellent results in comparison with two similar, but compound locomotives Nos. 73 and 49. On a nine days' test from October 16 to 25, 1901, running passenger trains averaging 35 axles and 360 tons from Grunewald to Saumerfauld and back (104 miles), the superheated locomotive consumed per train mile 34.2 lbs. of coal and 206 lbs. of water, with an evaporation of 6.05 lbs. of water per pound of coal. The compound locomotives consumed 37.8 and 38.2 lbs. of coal, respectively, and 279 lbs. of water per train mile, the evaporation in their case being 7.37 and 7.30 lbs. of water per pound of coal. The compound locomotives therefore required 11½ per cent. more coal and 30 per cent. more water than the superheater, but the boiler of the latter was evidently less efficient, as an evaporation of 7.35 lbs. saturated steam would equal 6.60 lbs. superheated 200 deg. Other tests with locomotives 2069 and 2070 showed equally good results, a saving of about 15 per cent. in coal being obtained with a steam temperature of about 520 deg. A large number of indicator diagrams from these tests are shown in Mr. Garbe's paper, and they are exceedingly satisfactory.

In 1901, trials were made by Mr. Von Borries on the Royal Hanover Railway, between a four-cylinder compound, No. 11, a two-cylinder compound, No. 38, and the first engine fitted with the smoke-box superheater, No. 86. These engines were all 2-4-0 passenger engines with driving wheels 78-in. diameter, No. 11 having 13-in. and 20½-in. cylinders, No. 38, 18.1-in. and 26.8-in. cylinders, and No. 86, 18.9-in. The length of run from Hanover to Stendel was 93½ miles. In these tests the consumption of coal and water and evaporation was as follows:

Engine No.	Coal per Mile.	Water per Mile.	Water per Lb. Coal.	Relative Coal.	Consumption Water.
11	38.8	280	7.27	98.0	110
38	37.8	294	7.78	95.5	115
86	39.6	255	6.44	100.	100

The superheater engine, while showing a saving of 10 to 15 per cent. in water as compared with the compounds, showed a loss of 2 to 4½ per cent. in coal, but this test has occasioned a large amount of controversy in Germany, and Mr. Garbe has pointed out that on the run on which these trials were made, the trains were lighter and the line less severe than in the case of the trials of engine No. 74, yet the coal and water consumption in the case of engine No. 86 was considerably greater than that of No. 74. Any one desiring a critical analysis of these tests can be gratified by referring to the Bulletin of the International Railway Congress for February, 1904, in which translated papers by Mr. Teuscher and Otto Berner were published.

In 1902 Mr. Von Borries made further trials between two new four-cylinder compounds, Nos. 17 and 18, two new superheated simples of the Schmidt smoke-box type, Nos. 439 and 440, and one two-cylinder compound, No. 42. The grate area of all these engines was the same, 24.43 sq. ft., and the heating surface of the three types, 1,277, 1,134 and 1,345 sq. ft., respectively. The boiler pressure of Nos. 17 and 18 was 210 lbs. and that of the others was 180 lbs. A large number of runs were made between Stendel and Hanover, the mean speed over a distance of about 75 miles averaging 54 to 56 miles per hour. The drawbar pull for the train was calculated by the formula:

$$T = W\left(0.8 + V\,\frac{V + 80}{17{,}300}\right)$$

that of the locomotive by:

$$T = W\left(1.9 + V\,\frac{V + 48}{5{,}760}\right)$$

where T is tractive force in pounds, W weight in tons (2,000 lbs.), and V, speed in miles per hour. The average temperature of the superheated steam in Nos. 439 and 440 was 527 deg., and the averages of the more important results were as follows:

Description	Nos. 17 and 18	Nos. 439 and 440.	No. 42.
Number of runs	20.	22.	12.
Duration of run, minutes	112.3	108.5	114.7
Net time of trip, minutes	107.3	103.5	109.7
Mean speed for 75 miles	54.8	56.4	54.
Weight of train, tons	315.	302.	284.
Water per round trip, pounds	51,160.	45,780.	50,100.
Coal, per round trip, pounds	6,662.	7,030.	6,472.
Water per mile, pounds	35.7	37.6	34.6
Coal per mile, pounds	274.	245.	268.
Water evaporation by coal	7.67	6.54	7.78
Relative evaporation	117.	100.	119.
Coal per H. P. hour, total pounds	2.08	2.17	2.32
Relative consumption	96.	100.	107.
Coal per H. P. hour at drawbar, lbs.	3.65	3.76	4.46
Coal per square ft. grate per hr., lbs.	76.3	83.3	73.2

In this test the superheater simple obtained results practically equal to the four-cylinder compound and superior to those of the two-cylinder. It was also worked rather harder, the average speed of the runs made by it being 2.9 per cent. greater than those made by Nos. 17 and 18. The boiler performance is again inferior to the engines without superheater, although better than that usually obtained in America, but as the superheat was about 150 deg., had the boiler efficiency been the same as on Nos. 17 and 18, the evaporation would have been 7.1 lbs. of water per pound of coal, and in place of the four-cylinder compound showing a gain in coal per total horse-power hour of 4 per cent., it would have shown a loss of 3 per cent. As a confirmation of this test, Mr. Von Borries states that the consumption of coal per mile for the same engine in regular passenger service was, during six weeks, 39.42, 40.16 and 39.81 lbs. per mile for these types, respectively, figures which agree fairly well with those obtained on trial. In some similar trials on the Halle Railway between the same class of four-cylinder compounds and simple superheaters, the results were as follows:

Description.	4-cyl. compound.	Simple superheater.
Coal, lbs. per mile	38.9	37.9
Relative consumption	103	100
Water, lbs. per mile	270.2	226.5
Relative consumption	119	100
Evaporation	6.96	5.98
Relative evaporation	116.5	100

In this test, the superheater engine has a slight advantage in coal consumption, but there is the same large difference between the water and coal figures, showing a decreased boiler efficiency in the superheater. Some 0-8-0 freight engines were also tested on the Royal Saarbrucken Railway, the superheater engines being simple and weighing 122,000 lbs., the two-cylinder compounds weighing 117,000 lbs., the train loads being practically proportional. The results were stated per 1,000 miles per axle and were as follows:

Description	Compound.	Superheater.
Coal burned, pounds	605.6	567.3
Relative performance	107.	100.
Water used, pounds	4,459.	4,070.
Relative consumption	110.	100.
Evaporation	7.38	7.18
Relative evaporation	103.	100.

It will be noticed that the boiler performance of the superheater in this case is decidedly better and that while the economy in

*Extract from a paper by H. H. Vaughan, Superintendent of Motive Power, Canadian Pacific, read before the American Railway Master Mechanics' Association, June 16, 1905.

water is not as great as in previous trials, yet the coal economy is better. This may be due to the engine not having been worked as hard as in the previous trials, and consequently those gases passing through the superheater would not leave it at so high a temperature. These tests have been presented at some length to show the possibility of a substantial economy in water being neutralized by a loss in boiler efficiency, and by this is not meant the decrease in the evaporation due to the additional amount of heat in the steam delivered to the engine, but a further decrease, which can only be due to one of two causes, the gases that pass through the superheater leaving it at too high a temperature or the reduction in the number of flues used for evaporative purposes increasing the velocity of the gases in those flues so that their temperature, when leaving, is too high. The latter reason does not appear possible and the Schmidt smoke-box superheater is certainly very liable to lead to the first, although it can be avoided by proper adjustment, and it appears probable that the poor boiler results in these trials may be accounted for in this way. It should be noted, therefore, that the superheater simples showed an economy in water of 14 to 15 per cent. over a four-cylinder balanced compound in passenger service which, allowing an average of 150 per cent. of superheat, would permit of an economy in coal of about 7 per cent., and that the average coal consumption in passenger service is actually the same, and in freight service better than the compound engine. An extensive test was carried out by Mr. Strahl, of the Breslau District of the Prussian State Railways, between two 2-4-0 passenger locomotives, No. 9 simple and No. 54 compound, equipped with the Pielock superheater, and two similar engines, No. 4 simple and No. 60 compound, using saturated steam. The results are given in the following table:

Description	No. 4.	No. 9.	No. 60.	No. 54.
Diameter of cylinder	16 15/16	16 15/16	18 1/8 and 26 25/32	18 1/8 and 26 25/32
Stroke	23 5/8	23 5/8	23 5/8	23 5/8
Diameter of drivers, inches	78	78	78	78
Heating surface, square feet	1,349	1,123	1,270	1,044
Superheater surface, sq. ft.	226	226	226	226
Grate area	24.43	24.43	24.76	24.76
Average weight of train, including engine and tender	283	283	309	309
Distance run, miles	1,193	1,193	2,360	2,360
Working pressure, pounds	170	170	170	170
Temperature of superheated steam in dome	500	500	446	446
Temperature of feed water, deg.	50	50	50	50
Average consumption of steam per hour, pounds	9,568	8,069	11,618	10,459
Average consumption of coal per hour, pounds	1,195	1,047	1,574	1,519
Economy of water, per cent.	16	16	10	10
Economy of coal, per cent.	12.3	12.3	3.5	3.5
Water evaporation per lb. coal	8	7.70	7.70	6.88

In these tests the saving in water was accompanied by a corresponding saving in fuel, although in the compound superheater the boiler performance drops off a little, although the superheat is low and, in fact, the superheat in these trials was only moderate and not as high as that advocated by Schmidt. In an article written by Mr. Strahl giving the results of his experiments, he arrives at the result that the locomotive with the superheater used almost exactly the same volume of steam as the locomotive without, and Mr. Strahl has also advised that this approximation holds very closely for other engines using superheated steam. He states that for several months some 0-8-0 engines with Schmidt smoke-box superheater have been compared with the same class without the superheater, and that the resulting economy in water has been 25.3 per cent., and in coal 15.25 per cent. On the basis of equal volumes with the degree of superheat obtained, the figures would have been 24 and 17 per cent., respectively. An interesting result arrived at by Mr. Strahl is that flat slide valves worked satisfactorily up to 520 deg. F. The German trials described above are remarkably uniform in one respect—the considerable water economy effected by superheating—and they also show that while a falling-off in boiler efficiency must be guarded against, it need not occur, at any rate, beyond 2 to 5 per cent. In the tests made by Mr. Von Borries, it must be remembered that the engine with which the superheater simple was compared is the most efficient type of compound, that the water economy shown in comparison with it is a high recommendation for the superheater, and in view of the probable improvements in boiler performance, it will, no doubt, in the future, be possible to show a corresponding economy in fuel.

Turning from the results obtained abroad to those in America, the only figures so far available are those on the Canadian Pacific, and on this road the records available are those obtained in service over a considerable period. These results, after all, must be the deciding ones, as in view of the influence of the boiler efficiency on the net economy, isolated tests will always be more or less unsatisfactory. It is possible to determine the water consumed per unit of power developed with considerable accuracy, but in determining the water evaporated per pound of coal, a factor must be taken into account that is independent of the boiler, and nearly everything else on the road, in the efficiency of the fireman. It is quite possible, on a test, to obtain an evaporation that is decidedly better than that realized day after day in service, and while no doubt careful tests are desirable, and it is the intention to carry them out as soon as a dynamometer car is available for the purpose, yet the service results are so far satisfactory and are interesting as showing the economy actually obtained.

The records from engine No. 548 extend over a period of 17 months, during which time this engine was compared with similar simple and Vauclain compounds in freight service and with simple and two-cylinder Pittsburg compounds in passenger service. The dimensions of the various engines are as follows:

Engine No.	548	616	595	634	482
Type	4-6-0	4-6-0	4-6-0	4-6-0	4-6-0
Kind	Simple	Simple	Compound	Simple	Compound
System	S. H. Schmidt S'box	.....	2-cylinder Pittsburg	.....	4-cylinder Vauclain.
Cylinders	18 x 24	18 x 24	20 & 30 x 24	18 x 24	13½ & 23 x 24
Drivers, inches	62	62	62	62	62
Heating surface, fire tubes and fire-box, square feet	1,116	1,291	1,291	1,428	1,614
Grate area	23.44	23.44	23.54	28.54	28.54
Boiler pres., lbs.	180	180	180	180	200
Wt. on drivers pounds	96,800	95,400	96,800	94,350	94,100
Total wt., lbs.	124,000	119,250	123,400	119,325	129,225
Superheating-surface, square ft.	307	.....	.....	.....	.....

These engines were compared for periods in which they were running in corresponding service to No. 548 between Montreal and Smith Falls, a practically level division with rolling grades with a maximum of 0.5 per cent., and the results were as follows: The column marked "Relative Economy," in each case showing the amount of coal consumed by engine No. 548 as compared to the engine with which it was tested:

	Engine.	Engine, Miles.	Ton-Miles, Thousands.	Coal Tons.	Coal per 1,000 Ton-Miles.	Relative Economy.
May, 1903, to December, 1903, Freight	548	34,493	33,183	1,514¾	93	81.5
	482	31,857	30,457	1,741¾	114	100.
January, 1904, to May, 1904, Freight	548	16,812	14,404	931	129	74.
	616	15,722	13,248	1,167	176	100.
June, 1904, to September, 1904, Passenger	548	15,768	2,451	467¾	382	81.5
	595	16,128	2,560	600	469	100.
	634	16,854	2,750	680¼	495	105.

Noting that Nos. 616 and 634 are simple engines and Nos. 595 and 482 are compounds, these results show satisfactory agreements and would show that this engine consumed about 75 per cent. of the coal required by a simple engine, and 82 per cent. of that required by a compound in similar service. The superheat obtained in this engine is, however, high, running from 550 deg. to 650 deg., according to conditions, and it may be considered as representing the extreme limit to which superheating can be conveniently carried. There is no doubt that the results that have been obtained are exceptionally economical and the engine has been a favorite with the men handling it in any service. The valve and cylinder arrangements of this engine were designed by Mr. Schmidt and have given entire satisfaction at the temperature mentioned above, although when the superheat was raised above 700 deg. a certain amount of trouble was experienced with the lubrication and packings.

The results from engines No. 1000 and No. 1300 extend over a period of nine and eleven months, respectively, during which time these engines were compared with engines identical in every respect except that of not being equipped with a superheater. The dimensions of these engines are as follows:

Engine No.	1000	996 and 997	1300	1319
Type	4-6-0	4-6-0	4-6-0	4-60
Kind	Compound	Compound	Compound	Compound
System	S. H. 2-cyl. Schmidt fire tube	Pittsburg 2-cyl.	S. H. 2-cyl. Schenectady, fire tube	2-cyl. Schenectady.
Cylinders	22 and 35 x 26	22 and 35 x 26	22 and 35 x 30	22 and 35 x 30
Drivers, in.	63	62	62	62
Htg. surf.*	1,888	2,420	2,492	3,065
Superheating surf., sq. ft.	350	....	390	....
Grate area, square feet	33.02	33.02	44.08	44.08
Boiler pressure, lbs.	210	210	200	200
Weight on drivers, lbs.	129,000	128,000	141,000	141,000
Total weight, pounds	172,000	169,000	192,000	190,000

*Heating surface, fire tubes and firebox, square feet.

Engine No. 1000 was compared with Nos. 996 and 997 for periods in which they were running in corresponding service between Montreal and Smith Falls in freight service. Engine No. 1300 was compared with No. 1319 in corresponding service between Chalk River and North Bay, and North Bay and Cartier; these divisions are very similar, Chalk River to North Bay being an undulating road with several grades four to seven miles long with occasional stretches of 1 per cent., but more generally 0.6 to 0.8 per cent., the total rise on the division being 135 ft. From North Bay to Cartier, the road is undulating, except for one rise of 480 ft. in 16 miles, the limiting grades being 1 per cent. and the total rise 230 ft. The results were as follows, arranged as for engine No. 548:

	Engine No.	Engine, miles.	Ton-miles, thousands.	Coal, tons.	Coal per 1,000 ton-miles.	Relative economy.
Montreal to Smith's Falls:						
January to July, 1904	1,000	21,567	25,321	1,271½	100	72
	997	19,662	23,278	1,499¼	129	100
August to Sept., 1904	1,000	3,740	4,657	188½	81	70
	996	5,666	7,026	409¾	116	100
Chalk River to North Bay:						
Nov., 1903, to Sep., 1904	1,300	22,987	17,075	1,127½	132	90
	1,319	19,983	15,091	1,112½	147	100
North Bay to Cartier:						
Nov., 1903, to Sep., 1904	1,300	10,964	9,887	550½	111	84
	1,319	10,521	9,249	616½	133	100

These results are rather more favorable to the superheater engines than would have been expected, espcially in the case of engine No. 1000, where it will be seen that this engine gave considerably better comparative results that No. 1300. These engines also being equipped with the smoke-tube type of superheater, did not obtain the same degree of superheat as No. 548, generally running from 500 deg. to 550 deg. There was a certain amount of leakage from the boiler of Nos. 1000, 996 and 997 class during the period, which makes the comparison of less value than those for No. 548 and No. 1300, but in spite of this, the results are evidently satisfactory.

The results from 20 Schmidt smoke-tube superheaters and 21 Schenectady superheaters have been obtained over a period of four months. These engines could not be compared with similar engines, but they are compared with the 1300 class referred to previously and with a class of compound consolidations termed the 1200 class. As will be seen by the table below, these consolidations, although lighter, are a very similar engine in every respect to the superheaters, as they are comparative in their dimensions and have the same grate area and type of boiler. The dimensions of these engines are as follows, the Schmidt superheater being the 1600 class and the Schenectady superheater the 1621 class:

	1200.	1600.	1621
Type	2-8-0	2-8-0	2-8-0
Kind	2-cyl. compound.	Simple superheater.	Simple superheater.
System	Schenectady.	Schmidt smoke-tube.	Schenectady smoke-tube.
Cylinders	22 and 35x28	21x28	21x28
Drivers	57 ins.	57 ins.	57 ins.
Htg. surf.*	2,218 sq. ft.	2,381 sq. ft.	2,870 sq. ft.
Superhtg surf.	.....	375 "	340 "
Grate area	43.64"	43.64"	43.64"
Boiler press.	200 lbs.	200 lbs.	200 lbs.
W't. on drivers.	143,000 lbs.	164,000 lbs.	164,000 lbs.
Total, weight	162,000 lbs.	186,000 lbs.	186,000 lbs.

*Heating surface, fire tubes and firebox.

The results obtained from these engines were as follows, the number of engines working being the actual number of different engines of the class included in the figures each month and the comparative economy being that of the various engines compared with the 1200 class where possible, or if none of those engines were working, with the 1300 class, and in one case with the 1621 class. The column, 1600 to 1621, shows the percentage of economy, or if negative, the loss of the 1600 over the 1621 class:

	Engine.	No. of class running.	Ton-miles thousands.	Total coal, tons.	Coal per 1,000 T. G. ton-miles.	Relative economy.	1600 to 1621.
		Chalk River to North Bay.					
January	1200	12	7,077	717½	202	100	21
	1300	1	865	80¼	199	98	
	1600	5	5,111	410½	160	79	
	1621	9	10,669	1,075	201	100	
February	1200	1	202	17½	173	100	14
	1300	1	1,354	117¾	173	100	
	1600	6	7,542	612¾	162	93	
	1621	8	8,728	824¼	188	108	
March	1200	1	316	24½	155	100	13
	1300	1	770	56	145	93	
	1600	6	6,175	423¼	137	88	
	1621	6	7,095	560¼	157	101	
April	1600	5	6,179	374¾	121	93	7
	1621	6	9,886	645¼	130	100	
		North Bay to Cartier.					
January	1200	10	6,393	499	156	100	4
	1300	1	713	48½	136	87	
	1600	4	2,008	146	145	93	
	1621	6	9,307	708¼	152	97	
February	1200	2	1,590	137½	172	100	16
	1300	1	565	44¼	156	91	
	1600	6	6,043	423¾	140	82	
	1621	8	5,052	429	167	97	
March	1200	3	1,377	100¼	145	100	14
	1300	1	728	50	137	95	
	1600	5	4,825	294	121	83	
	1621	6	5,360	378¼	141	97	
April	1200	1	365	26	143	100	8
	1300	1	191	9¾	102	71	
	1600	5	6,322	367½	116	81	
	1621	6	5,599	352¾	126	88	
		Chapleau to White River.					
January	1300	3	3,755	340¼	181	100	25
	1600	13	13,950	1,267¾	181	100	
	1621	5	612	74½	243	132	
February	1300	4	2,696	239	177	100	
	1600	9	13,226	1,050¼	158	89	
March	1300	3	4,821	400¼	164	100	
	1600	10	19,106	1,348	141	86	
April	1300	4	2,518	193	153	100	
	1600	9	11,894	738¾	124	81	
		Cartier to Chapleau.					
January	1300	3	3,373	322¾	191	100	12
	1600	11	14,547	1,209¼	166	87	
	1621	7	1,170	110½	188	98	
February	1300	3	3,970	332¾	167	100	
	1600	9	13,176	996¾	151	90	
March	1300	3	3,305	246¼	149	100	6
	1600	11	21,942	1,450	136	91	
	1621	1	265	17	128	86	
April	1300	3	2,726	204¾	150	100	
	1600	9	12,814	766¾	119	79	
		Megantic to Farnham.					
January	1200	6	759	124¾	328	100	
	1621	7	13,595	2,164½	318	97	
February	1200	4	879	177¼	403	100	
	1621	7	12,639	2,060½	326	81	
March	1200	1	170	32	378	100	
	1621	8	15,481	2,153¼	278	74	
April	1200	1	1,033	152¼	295	100	
	1621	8	13,923	1,820¼	261	89	
		Farnham to Outremont.					
January	1200	8	1,120	126¼	225	100	
	1621	4	1,800	186	206	92	
February	1200	4	1,754	211	240	100	
	1621	7	801	105½	263	109	
March	1200	2	1,228	112½	183	100	
	1621	3	821	83	202	110	
April	1200	1	49	5½	224	100	
	1621	1	52	6	230	102	
		Newport to Farnham.					
January	1200	4	611	102¼	334	100	
	1621	6	1,807	261¼	289	87	
February	1200	2	946	137	289	100	
	1621	4	1,184	177¾	300	104	
March	1200	2	1,036	148¼	286	100	
	1621	1	282	37¼	264	92	
		Brownville to Megantic.					
January	1200	12	5,364	677	252	100	
	1621	6	12,113	1,429¾	236	94	
February	1200	12	6,991	982½	281	100	
	1621	6	4,686	801¾	342	122	
March	1200	12	7,907	949¼	240	100	
	1621	4	9,447	1,064	225	94	
April	1200	14	6,319	720¼	228	100	
	1621	4	7,837	923½	235	103	

Reference has already been made to the nature of the divisions, Chalk River to North Bay, and North Bay to Cartier, shown in the above table; Cartier to Chapleau and Chapleau to White River are practically similar, having undulating grades with 1 per cent. limit, and a maximum rise or fall of 200 ft.; both divisions are, very largely, short grades, with very little level track, but the net rise is only 110 ft. in the latter case, and the former is practically level. Farnham to Megantic is a very heavy division in the direction of traffic, rising 750 ft. in 33 miles, with grades of 0.7 to 1.0 per cent., undulating seven miles with a drop of 10 ft., limiting grades 1 per cent., falling 135 ft. in five miles, limit 1 per cent., undulating with short 0.6 and 1 per cent. grades 22 miles with a drop of 200 ft., rising 330 ft. in six miles, limit 1.3 per cent., down 330 ft. in six miles, limit 1.3 per cent., rising 640 ft. in 47 miles, with limiting grades of 1.3 per cent. and drops of 232 and 400 ft., besides smaller ones.

Farnham to Outremont is undulating with short grades of 0.6 and 0.75 per cent. Farnham to Newport is heavy in direction of traffic, rising 236 ft. in 20 miles, limiting grade 1 per cent., 119 ft. in four miles with grades 1.4 and 1.66 per cent., dropping 162 ft. in seven miles, 1 per cent. grades, undulating 18 miles, rising 422 ft. in 11 miles, 1.5 per cent. grades and dropping 255 ft. in four miles, 1.5 per cent. grades. Brownville to Megantic in direction of traffic, rising 640 ft. in 15 miles with limit of 1.2 per cent., dropping 700 ft. in 13 miles, grades up to 1.2 per cent., undulating 58 miles with grades up to 1½ miles long of 1.0 per cent., dropping 480 ft. in 13 miles, 1 per cent., undulating 11 miles, dropping 370 ft. in seven miles, grade 1 per cent.

From an inspection of this statement, which is simply an analysis of the regular road records for five months, it will be seen that the results obtained from the 1600 class are decidedly superior to those obtained from the 1621 class. This is due to the higher superheat in the former engine, which is about 100 deg. as against 50 deg. in the case of the latter; in neither is as much obtained as is desirable, but still good results have been obtained. The only case in which No. 1621 shows the better results is for a round trip in March, and it is not reasonable to place reliance in coal figures for one trip on account of no proper allowance being made for the coal on the tender. There is, however, a very general agreement that the 1621 class are equally as economical as the compounds and the 1600 class about 10 per cent. better, and while it is impossible to say definitely that this is due to the superheat, yet the fact remains that the 1200 and 1300 class engine were previously the most economical on fuel on the road, and yet, as shown, the 1600 class engines have given superior results. No doubt, the experience so far gained is hardly sufficient for a definite conclusion, but it certainly can be said that the results to date are exceedingly satisfactory.

GENERAL CONCLUSIONS.

The use of superheated steam does not entail the multitude of practical difficulties that so generally accompany any invention or improvement that is introduced to improve the economic results obtained from a locomotive, and indeed, it is probable that as experience with its application develops, some of the expenses that are incurred in the locomotive of to-day will be diminished rather than increased. There would only appear to be two possible sources of additional cost, the wear of valves and cylinders due to defective lubrication, and the cost of maintaining the superheater itself. So far as has been learned at present, the lubrication of superheater engines is not different from that of other engines, with the exception that the lubrication must be accomplished, and it is not sufficient to hope that the oil gets to the designed spot. For this purpose a positive feed lubricator is required, and this should preferably be provided with six feeds, so that pipes may be led to each end of the valve and to the cylinder. It should also be possible to vary considerably the amount of oil fed per minute, as superheater engines, even more than those of the ordinary type, require more oil when working slowly at long cut-offs than at other times, on account of the high temperature of the steam being maintained throughout the stroke. This can be effected either by supplementary oiling or by an easy adjustment of the lubricator allowing a large amount of oil to be fed at low speed, but the latter will be preferable if obtained without complication. With proper lubrication there appears to be no additional wear of valves or pistons,

and while a special mixture of metallic packing must be used, it has given, if anything, less trouble on the superheaters than on the other engines. On engine 548, in which the steam was superheated as high as 700 deg., it was found that the ordinary valve oil was not suitable and that the rod packings would melt out, but by reducing this from 550 deg. to 600 deg., these troubles were not experienced, and no difference is noticed between an operation of this and an ordinary engine. The valves used on No. 548 are Mr. Schmidt's design, but with split ring packing in place of the solid ring used in Germany, so that they are practically similar to the piston valves in general use, except in their being of smaller diameter, 6 in. for an 18-in. cylinder, and double ported. The packing rings, in place of being narrow, are comparatively wide, and on the surface there are several water grooves. These rings have given exceedingly good service, but in view of the successful use of split rings it is difficult to see any reason why valves of the ordinary design should not be entirely suitable for superheated steam, the only point to consider being whether small double ported valves would not be preferable to the large single ported valves at present in use, and whether wide rings with water grooves would not give better results than narrow plain rings. It is natural that, on account of the reduced weight of the superheated steam, a smaller admission area can be used than that required for saturated steam, but for equal flows under equal heads, the rate is only 10 to 9 and 8, for steam superheated 100 deg. and 200 deg., respectively, so that the dimensions adopted by Mr. Schmidt must be entirely ascribed to the use of double ported valves. Those engines on the Canadian Pacific having smoke-tube superheaters which have not developed the same degree of superheat as engine 548, have given, so far, no trouble with their valves, pistons and packing, when properly lubricated, and while there is room for considerable improvement in positive feed lubricators before an entirely suitable design is obtained, it is safe to say that with proper lubrication there will be no greater expense in maintaining the engine on account of using superheated steam.

The repairs to the superheater proper are at present difficult to determine; the smoke-box superheater certainly entails an additional expense when flues are renewed, as it has to be entirely dismantled in order to get at the tube sheet, but while it is said to have given some trouble in service in Germany, such has not been the case in three years' experience on the Canadian Pacific. Some trouble was at first experienced with the joint between the large tube and the back tube sheet, but this was overcome by properly thinning the edges of the lap, as in firebox construction. There has been no leakage from the various joints in the front end and, in fact, so far nothing has developed that would lead to any additional expense in maintenance.

The smoke-tube superheaters of the Schmidt type have given no trouble in service, but the arrangement of bolts and clips for securing pipe flanges to the headers is inconvenient, and it is quite difficult to make the joints perfectly tight to commence with; once tight, however, they do not appear to develop leakage, and it seems probable that by the independent bolting now arranged for there will be no difficulty in this respect. In the Schenectady type there has been no trouble with the headers, but the ends of the superheater pipes toward the fire-box have blistered in a number of cases, due to the dampers not operating properly and allowing the pipe end to become overheated; this has been overcome by welding a solid plug into the end of the pipes, which should remedy the defect as in the Schmidt design, in which steel return bends are used; this action has not developed, as the metal is sufficiently thick to stand a considerable temperature without deforming when steam is admitted. The dampers must, however, be kept in an operative condition, as otherwise, when the blower is applied with a hot fire immediately after shutting off, the pipes may be subjected to an intense heat, which is unsafe in view of their containing no steam. The 5-in. tubes have not been giving any especial trouble; in fact, they have lasted as well as the smaller tubes; this applies, of course, to good water districts, and there is no available experience to determine whether, on bad water, they would stand up until the other tubes need renewal, but it is evident that their position in the flue sheets is favorable and the circulation around them is better than around the more closely spaced fire tubes.

As a matter of fact, it is too early yet to say anything definite about the expense of maintenance of superheaters; there is, of course, a possibility of a comparatively rapid deterioration of the pipes occurring, but there does not appear to be any immediate expense that will develop in one or two years' service. On the other hand, there is the advantage of decreased evaporation for the same work that occurs in compounds on account of their increased efficiency, and there is also an advantage in the dryness of the steam and reduced liability of water in the cylinder. On the smoke-box superheater with its high superheat, it is almost impossible to work water over into the cylinder, excepting when first starting out before the apparatus has been warmed up, and while this is not the case to the same extent with moderate superheaters, it is an advantage to a certain degree.

A possible advantage of superheating has not been utilized in its application in America, namely, a reduction in boiler pressure without loss in efficiency, although in Germany this has been usual. There is no doubt that the increase of pressure from 175 to 200 and 210 lbs. that has taken place within the last few years has been of doubtful advantage. While there is a gain in economy, this is accompanied by an increase in the losses due to leakage, both in engine and boiler, and by a considerable increase in the cost and trouble of boiler maintenance. By superheating, the initial pressure becomes of less importance, and with the proper amount of superheat, it will be possible to return to pressures of 175 lbs. or less, without any appreciable loss in economy, and with a relief from those boiler troubles which have become more serious as the pressure, however, when accompanied by a corresponding increase in alone will overbalance any additional expense connected with the maintenance of the superheater.

Herr Garbe, in addition to the reduction of boiler pressure, advocates a still further advance, namely, the enlarging of the cylinders sufficiently to develop the full power of the engine, with cut-offs of 30 to 33 per cent. A reduction in power is then effected chiefly by throttling, the cut-off remaining practically constant. This method may possibly prove advisable in American passenger work, but it does not appear practicable for freight locomotives. It is evidently impossible to develop the same tractive power with a given weight on drivers, with a cut-off of 30 per cent. as with 80 per cent., since there is a greater variation in the maximum effort in the former case, and with the conditions here prevalent, where the loading is so closely equal to the capacity of the engine, a reduction in capacity could not be tolerated. A reduction in boiler pressure, however, when accompanied by a corresponding increase in the cylinder dimensions, does not affect the tractive power and would appear to be a decided advantage.

In general, therefore, it may be assumed that the maintenance of locomotives using superheated steam will not be necessarily greater than that of ordinary locomotives of similar size, as, although certain additional expenses are introduced, these are offset by economies in other directions, and the net result will not be very much different. If this position is correct, the advisability of superheating depends entirely on the relation between the initial additional cost and the saving obtained, and as, at present, the cost of applying a superheater is about $1,000 per engine, and the tendency will be rather to reduce this amount than increase it, it is evidently a very good investment. A 200,000-lb. freight engine making 30,000 miles per annum will burn about 2,500 tons of coal, which, at $2 per ton, costs $5,000, so that evidently a saving of 10 per cent. will pay 50 per cent. of the additional cost per annum, and it appears perfectly safe to state that with a superheater at least that amount can be saved. While slightly more expensive, at first cost, than compounding, there is in the application of superheated steam a possible development in locomotive engines, which obtains at least as great an economy in fuel, which is practicable and without complication in its construction, which costs nothing extra for maintenance, does not reduce the efficiency of a locomotive in any way as a mover of freight, and which, without any desire to appear too enthusiastic, certainly promises to become one of the greatest steps in the direction of economy that has been introduced for many years past.

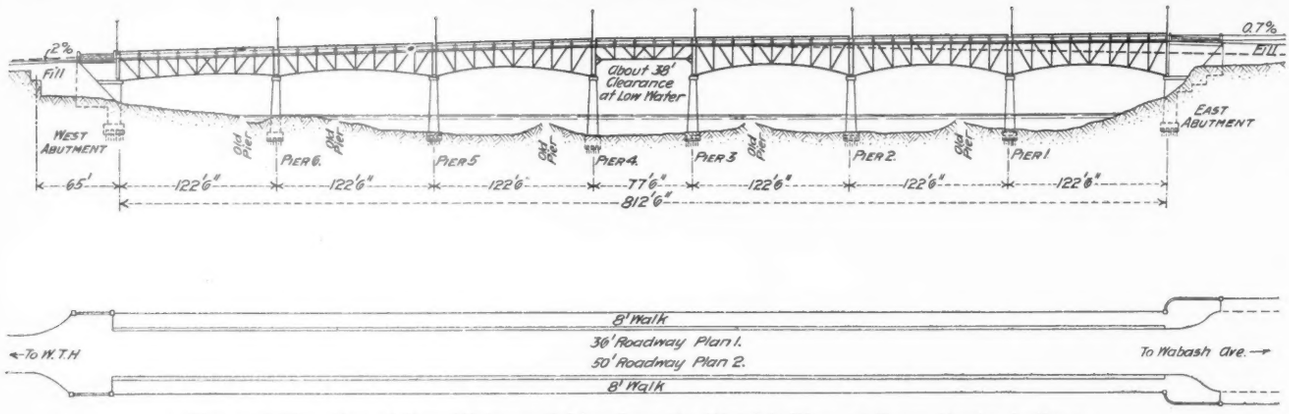
Railroad Legislation in Michigan.

While the session of the Michigan legislature just closed has not been prolific in the number of railroad bills passed, a number of measures have been enacted into law that are of interest and importance to the railroad properties in the state. The most important ones are those affecting the state tax commission and the assessment and taxation of railroad property. Under the present law the tax commission composed of five members assesses the railroad property at its true cash value, and levies against such property a tax at the average rate paid by all other classes of property for all purposes for the preceding year.

When the first assesment was made under this law, the board became satisfied that other properties were not assessed at their cash value, and levied a tax at what they determined would be the average rate upon the basis of the true cash value of such other property. This action was reviewed by the courts, and much bitterness was engendered against two members of the commission on account of their making, for the railroad companies, affidavits of their findings and belief regarding the assessment of local property, and the injustice to the railroad companies of that provision in the law, but the court held that the law was mandatory in its terms, and that no discretionary power was vested in the commission.

The laws just passed provide for the legislating out of office the present commission, effective Nov. 1, 1905, and for the appointment by the governor of a new commission consisting of three members. They also give the board power and authority, while acting as a board of assessors, to make a full and thorough investigation of all assessments in the state, and to fix the rate of tax to be paid by railroad companies upon the basis of the true cash value of all property in the state, according to their best judgment, without reference to the assessed value by the local officers.

Another measure of some importance gives the Attorney General



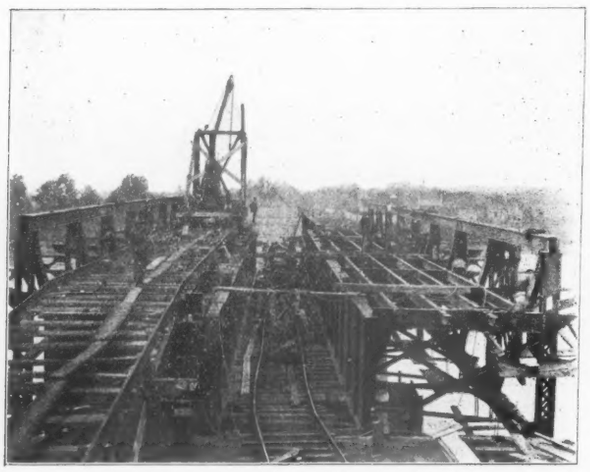
Plan and Elevation of New Highway Bridge Over the Wabash River at Terre Haute, Indiana.

free access to all books and accounts of the Michigan Central for the purpose of securing information to be used in suits now pending against that company by the state. This was bitterly fought by those who believed that it was in the nature of class legislation, and that all corporations and persons should be subject to the same general law upon this subject, but it became a law.

Another law gives electric and street railway companies the same right of eminent domain for the condemnation of property as is now given to companies organized under the general railroad law, and provides that the railroad commissioner may order and require fencing and farm crossings on such lines, the same as is now done with steam roads. Bills were also passed providing penalties for either steam or electric roads making crossings of the tracks of any other roads until such crossings have been regularly approved either by the commissioner of railroads or the board of railroad crossings.

Highway Bridge Over the Wabash at Terre Haute, Indiana.

This bridge, now nearing completion at the foot of Wabash avenue, replaces an old wooden Burr bridge erected in 1864 by a private company and operated as a toll bridge until bought by Vigo County in 1874. The old bridge consisted of five three-truss spans approximately 160 ft. each in length, and a short draw span of the tipping style. The grade was level and the floor about 5 ft. above maximum high water. The piers were composed of stratified limestone on wooden grillage supported by piles. The timber in the old bridge was remarkably well preserved but brash, most of it being



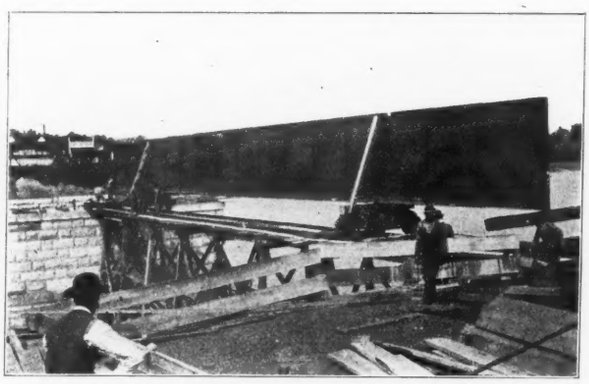
View Showing Traveler and Girders in Place.

yellow poplar in the trusses with a few main braces of oak. The masonry was so badly weather checked that it was all condemned and used for riprap around new piers.

The new bridge is composed of six 120-ft. spans and one 75-ft. span in the center. The roadway is 50 ft. between curbs and the two sidewalks are 8 ft. wide. As the War Department demanded 38 ft. clear headroom above the water under the 75-ft. span (which is a movable span without machinery until the War Department shall demand its installation), the floor is about 14 ft. above the elevation of the floor of the old bridge in the center and slopes down towards the ends with a grade of 1.225 per cent.

The six 120-ft. spans are composed of two riveted trusses about 53 ft. center to center, and three plate girders each 121 ft. 6 in. long. The trusses have the centers of the top chords 4.5 ft. above the top of the curb and form a barrier between the roadway and the sidewalks. The sidewalks are supported by brackets riveted to the posts of the trusses. The sidewalk stringers rest on the brackets and carry a cement finish on buckled plates riveted to the stringers.

The roadway is paved with brick on a Portland cement concrete foundation supported by buckle plates riveted to stringers. Between the trusses and the adjacent plate girders, the stringers are riveted between the floor-beams while between the plate girders they rest on top of the floor-beams. Two lines of rails on steel ties traverse the roadway at the center for interurban cars. The riveted trusses have the ordinary chord section for the top chord, built-up channels for the bottom chord, rolled channels for the verticals and four angles connected by a ¼-in. plate for diagonals, the plate not being consid-



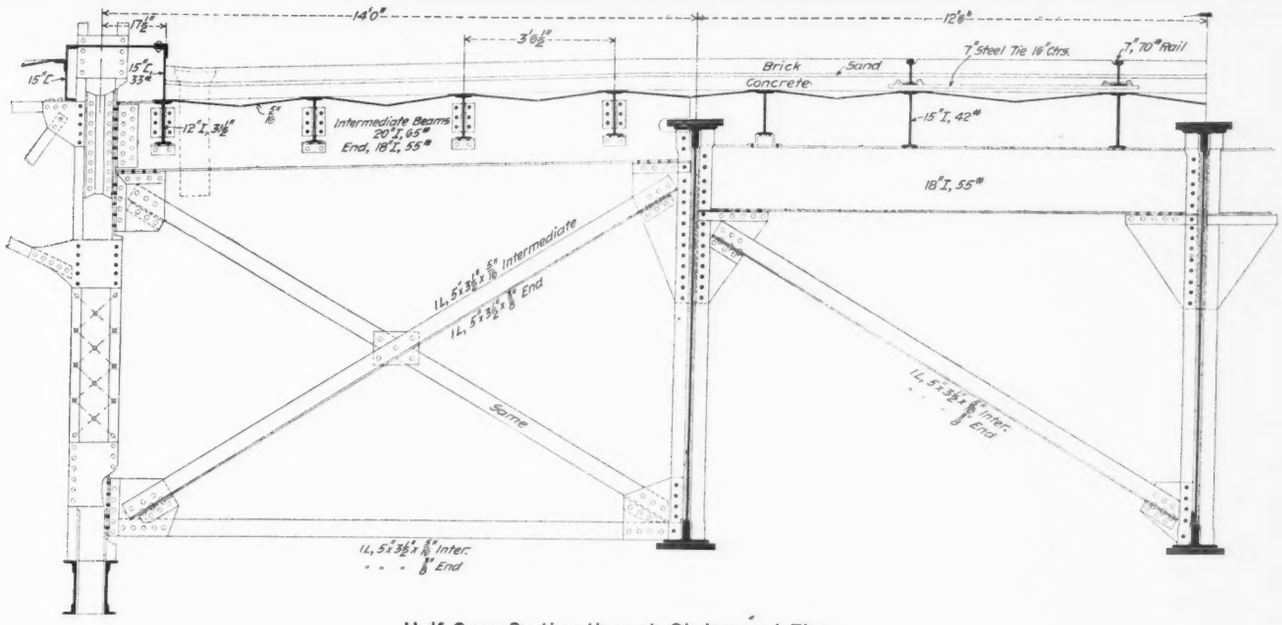
Placing 120-ft. Plate Girder in Position.

ered as part of the sectional area. The sidewalk brackets are riveted to the stay plates on the verticals. The expansion of the trusses is provided for by 8-in. segmental cast-steel rollers on T-rails which extend under the bearings of the adjacent span. The plate girders are the longest used up to this date for a highway bridge. They were shipped complete in pairs on three cars.

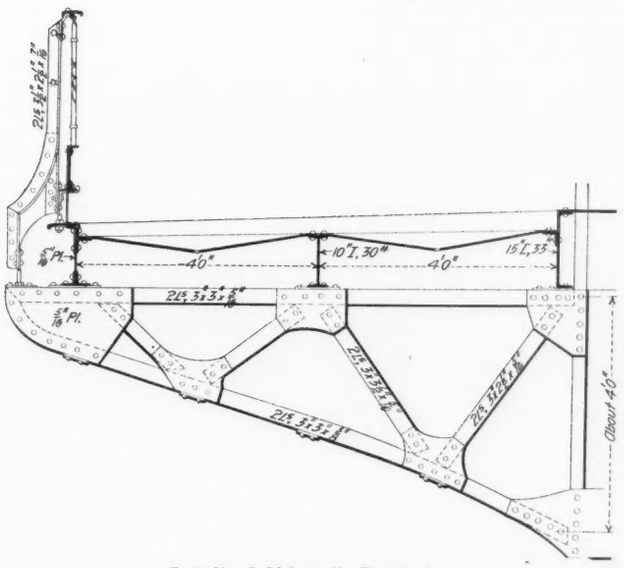
The substructure is composed of quarry-faced ashlar and concrete, on pile foundations. The bottom of the concrete masonry is 9 ft. below low water in the piers and extends to low water where the ashlar facing of Bedford limestone commences. This is backed with concrete.

The abutments are on piles, but the bottom of the masonry extends but 2 ft. below low water. The wing walls are not bonded

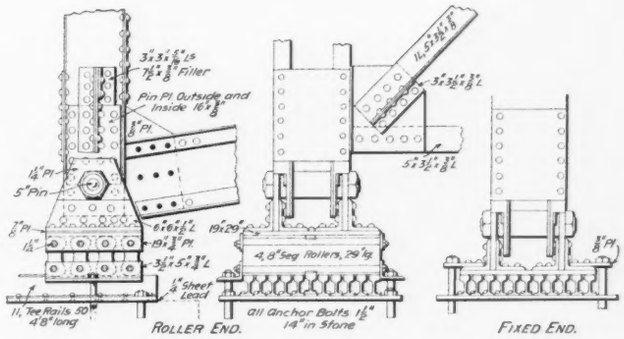
Truss Girder Erected and Ready to be Moved into Position.



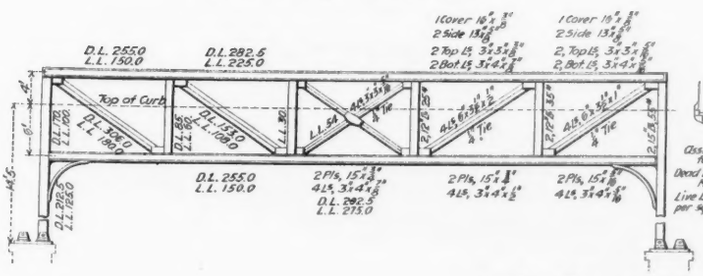
Half Cross-Section through Girders and Floor.

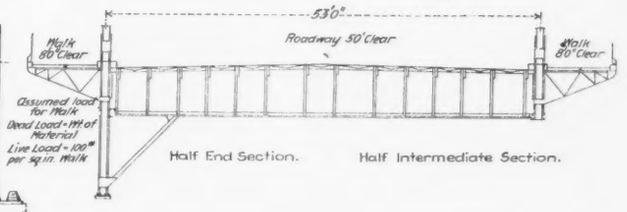


Detail of Sidewalk Bracket.

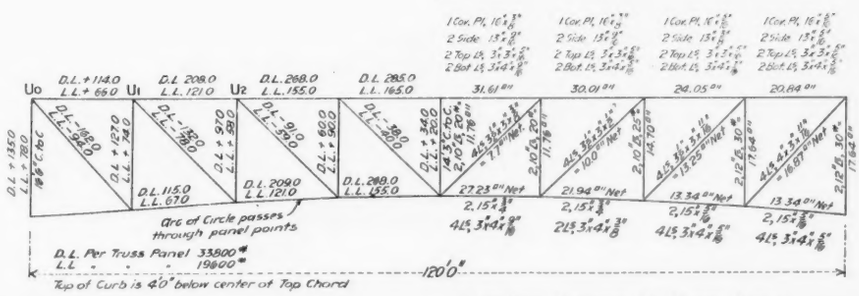


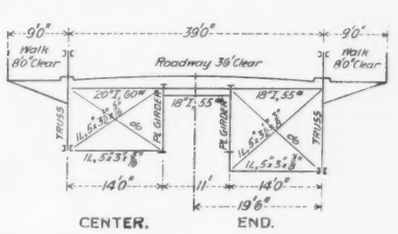
Details of End Bearings for Truss Spans.





Loading Diagram of Center Span.





Loading Diagram for Truss Spans.

to the abutments and rest upon the soil. The old abutments were upon the soil at an elevation some 10 ft. higher than the bottom of the new masonry. The pile driving was a slow process as the piles drove hard in the sand and gravel bottom. A drop hammer was used throughout the work, and in the east abutment foundation a water jet was successfully used until a penetration of about 16 ft. was reached, when it became useless; the driving was then continued with a hammer until a penetration of 20 ft. was reached.

The net quantities of masonry are as follows:

East abutment	1,330 cu. yds.	Pier 4	670 cu. yds.
Pier 1	630 "	" 5	650 "
" 2	650 "	" 6	630 "
" 3	670 "	West abutment	1,000 "

Piles of green hardwood to the number of 718 were driven—88 under each pier, 116 under the east abutment, and 84 under the west abutment.

Some of the shipping weights of the steel are given below:

Cast-iron drain pipes, etc.	7,477 lbs.
Sheet lead	8,321 "
Steel ties and rail clips	101,672 "
Street car rails	88,227 "
Buckle plates	689,855 "
Railings	74,300 "
Invoices 10 to 47	3,306,946 "
Total	4,159,328 lbs.
One 120-ft. plate girder	60,500 lbs.
One 120-ft. riveted truss	51,400 "
One intermediate sidewalk bracket	750 "
One light pole	1,250 "
One 75-ft. riveted truss	40,000 "
One intermediate floor-beam, 75-ft. span	16,000 "
One set cast-steel rollers	792 "
One wall plate of T-rails	1,280 "

There were about 125,000 open holes to be filled with ¾-in. and ⅞-in. rivets. Of this number a comparatively few were filled with bolts. Curb angles, stringer shelf angle connections were bolted, and a few end floor-beams, where it was impossible to drive rivets, were connected with turned bolts having a driving fit and nut and washer on each end.

The contract price for the entire structure, including a temporary bridge, the removal of the old superstructure and substructure, etc., was $271,200, of which $192,500 may be considered as the cost of the new superstructure, the temporary bridge and the removal of the old bridge, and $78,700 the cost of the substructure and approaches.

The method of erection may be briefly described as follows: Falsework capable of carrying a single line of railroad track was built between two of the 120-ft. plate girder positions. A single girder was loaded on two standard freight car trucks and then, by means of tackles, moved out until the ends were over the masonry, where it was placed on blocking and moved sidewise until in its proper position. When the girders for a span were in position, the floor-beams, stringers and sway bracing were put in place and bolted up. The riveted trusses were assembled by placing the floor-beams running from the trusses to the adjacent girders on top of the deck already formed and anchoring them down with the outer ends projecting beyond the girders about 2 ft. Then the truss verticals were bolted in place and the remaining members assembled and bolted. The outside rivets were driven and then the truss and floor-beams moved sidewise and lowered into their proper positions. One-half of the bridge was erected in this manner and then the falsework for three spans was moved forward, the railroad track being shifted to the lower flanges of the plate girders in place.

The only delay in traffic experienced was a few hours Sunday afternoon, when the ice took out the temporary bridge, and a few hours on the following Monday required to complete a plank roadway on top of the buckle plate floor. Some of the trusses had not been riveted up when this occurred, but the joints were securely held in place with bolts and drift pins. Sixteen feet of the roadway was used for traffic while one-half was paved; then the traffic was turned on the pavement and the remainder paved. Practically all rivets were driven with pneumatic hammers and heated in oil furnaces.

The contractor for the entire work was the Lafayette Engineering Company, Mr. Wallace Marshall, President; Mr. Frank Hanna, General Manager at Terre Haute, and Mr. O. G. Wright, Superintendent of Erection. The steel work was fabricated at the Detroit branch of the American Bridge Company. The mill and shop inspection was done by the Pittsburg Testing Laboratory. Mr. Malverd A. Howe and Mr. J. E. Starbuck were designing engineers and Superintendents of Construction for the Commissioners of Vigo County.

A Berlin physician, professor and official, made a tour to Trieste with his automobile, and on his way back shipped his machine home from Munich by rail, unmindful of the fact that there were some five gallons of benzine remaining in the tank, and also unmindful, and possibly ignorant, of the fact that according to the German traffic regulations benzine, because of its inflammability, must be particularly described when shipped, and if not so described is taxed 12 marks per kilogram, including the package, in addition to the freight as billed by the shipper. Twelve marks per kilogram is, as near as may be, $1.22 per pound. The railroad agents discovered the benzine, reckoned the whole automobile as the package—which it was—and made out the freight bill accordingly, which is said to have amounted to more than $5,000, which the doctor paid under protest. The chance tourist, Yankee or other, should bear in mind that a box of matches in his trunk renders the trunk and its contents liable to this charge—but, unless there is a custom house on the route, the presence of the matches will not be discovered.

Storage vs. Primary Batteries.

At the last meeting of the Railway Signal Association Mr. J. W. Gladstone, of the Battery Supplies Company, read a paper giving the cost of certain installations of caustic soda batteries for automatic signals, and comparing the figures for these batteries with those which had been given for storage batteries in a paper presented by Mr. Reynolds at the March meeting of the Association. On the Central of New Jersey the primary batteries used for 110 miles of signals (double track) between Bound Brook and White Haven have given for the last five years an average service of 10 to 12 months, 16 cells of battery being used at each signal. The first cost was $8,267 (3,984 cells at $1.95 each, $7,769; labor of installation, $498; maintenance (1 1-5 cells per year at 75 cents), $3,586. Mr. Gladstone in comparison with these figures estimates the cost of storage battery for the same signals at $37,719 and maintenance $4,718. For the storage batteries he would have five charging stations, and in the cost of maintenance he would include five per cent. on the excess of investment required for storage above primary batteries and 10 per cent. depreciation on this excess. He thus shows a saving of $1,132 a year in maintenance by the use of primary batteries, and claims even a greater saving than this because the cost of primary batteries includes the first charge for each cell, so that there is no expense for renewal for the first 10 months, so that the final comparison shows that the storage batteries will cost 44 per cent. more than primary batteries.

Referring to the installation on the Lackawanna road spoken of by Mr. Reynolds, Mr. Gladstone said that the cost of 160 battery boxes ($1,040) should not be included unless a deduction was made for the battery box provided in the signal post, which costs $25 a signal. Making this allowance he finds the first cost of storage battery equipment to be ten times greater than that of primary batteries. He also complained of the omission of interest charges in Mr. Reynolds' comparison. Again, the comparison of the cost of battery men, labor, etc., was inexact.

Where storage batteries are carried to and from signals on cars the question of transportation is a considerable item, as the cells must be handled with great care; so that this expense must not be assumed to be the same as the expense of transportation of primary batteries, for which material is sent packed in boxes, and this at any convenient time and at no risk.

Speaking of tests, Mr. Gladstone cited an experiment on the Lackawanna road where batteries were worked every half minute 10 hours a day for two months without a battery failure. In this and in a similar test on the Central of New Jersey each battery served for 60,000 signal movements before failing. As to withstanding cold weather, caustic soda batteries will make no trouble if put in boxes 24 inches deep, sunk in the ground to the level of the lid. Moreover, such boxes are cheaper than the cast iron cases which are a part of the signal post. These cost $25 each. The Michigan Central has 600 caustic soda batteries in shallow boxes which have worked well for five years. The Lackawanna has 100 of these in the Pocono mountains, where the batteries gave no trouble during the intense cold of winter before last; and last summer the Lackawanna put in all its remaining caustic soda batteries (700 signals) under ground.

June Railroad Decisions.

The following abstracts cover decisions on railroad cases in the United States Supreme Court and the Federal courts for the month of June:

Service of Process on Director of Foreign Railroad Company.—The service of summons on a director of a railroad company of another state who is casually within the state for a few days will not confer jurisdiction on a Federal court, where the railroad company is doing no business and has no property in the state where the process is served. Remington vs. Central Pacific R. Co. (U. S. Sup.), 25 Supreme Ct. Rep. 577.

Adjustment of Compensation for Carrying Mails.—The compensation for carrying mails may be adjusted as to an extension constructed since a former adjustment, and may be confined to the extension alone without readjusting the compensation for the whole route as extended. Chicago, Milwaukee & St. Paul Ry. Co. vs. United States (U. S. Sup.), 25 Supreme Ct. Rep. 665.

Taxation of Coal Outside the Taxing State.—The appraisement of railroad property for taxation under the revenue laws of Pennsylvania should not include the value of coal mined in the state, but

outside the state awaiting sale at the time the appraisement is made. Such action by the tax officers amounts to a deprivation of property without due process of law. Delaware, Lackawanna & Western R. Co. vs. Commonwealth of Pennsylvania (U. S. Sup.), 25 Supreme Ct. Rep. 669.

Lookouts on Trains.—The Tennessee statutes requiring lookouts to be stationed on locomotives, whose duty it is to sound the whistle when any person or object appears on the track, and construed by the state courts to allow recovery of damages by persons injured where this precaution is not observed, though the injured person is guilty of contributory negligence, does not apply in favor of the foreman of a railroad construction gang killed as the result of being struck by a locomotive which he had seen approaching while standing near the track clearing it for the train to pass. Rogers v. Cincinnati, New Orleans & Texas Pacific Ry. Co., 136 Federal Rep. 573.

Care in Transportation of Mail Clerks.—A railroad company owes the same degree of care to a mail clerk riding in a mail car in charge of the mail that it does to passengers for hire on the train, and that care is prescribed by law to be the highest degree of care, skill and foresight consistent with the carrying on of its business. Cavin vs. Southern Pacific R. Co., 136 Federal Rep. 592.

Notice of Claim for Injury.—The requirement of four months' notice of a claim for injuries under the Connecticut statutes cannot be invoked in a sister state in which the action for the injuries is brought where no such condition is imposed. Brown vs. New York, New Haven & Hartford R. Co., 136 Federal Rep. 700.

Expert Evidence as to Speed.—A railroad conductor long in the service of a railroad company and familiar with the locality of a railroad crossing accident is competent to testify as an expert as to the speed at which a locomotive was propelled at the point in question. Baltimore & Ohio Railroad Co. vs. Connell, 137 Federal Rep. 8.

Overhead Bridges.—In the trial of a suit for injuries to a brakeman by striking a low trestle with which he was unfamiliar, an expert in railroad management is qualified to testify what, in his opinion, good railroading requires with respect to tell-tales on each side of overhead bridges. Pittsburg S. & N. R. Co. vs. Lamphere, 137 Federal Rep. 20.

Mechanics' Liens.—The furnishing of proper materials for the construction or improvement of a railroad is sufficient to sustain a mechanic's lien under the laws of Missouri without proof that the materials were used for that purpose. Westinghouse Air Brake Co. vs. Kansas City Southern Ry. Co., 137 Federal Rep. 26.

Removal of Causes to Federal Court.—An action in a state court to recover for injuries alleged to have been caused by failure to equip cars with safety appliances is not to be removed to the Federal court on the sole ground that it is alleged that the defendant is engaged in interstate commerce, since the question of fact whether the defendant is engaged in interstate commerce, and if so whether it has complied with the law, are not federal questions. Myrtle vs. Nevada C. & O. Ry. Co., 137 Federal Rep. 193.

Liability of Lessor Road for Illegal Acts of Lessee.—A railroad company leasing its lines to another company is not liable for the illegal acts of the lessee in carrying oil at a discriminating rate during the continuance of the lease. Western New York & Pennsylvania R. Co. vs. Penn Refining Co., 37 Federal Rep. 343.

Findings of Interstate Commerce Commission.—The provision of the Interstate Commerce act that the findings of fact of the Commission shall be prima facie evidence of the facts found in a subsequent proceeding to enforce the Commission's order, contemplates a clear-cut finding so prepared and arranged in the report that it can be offered in evidence unaccompanied by arguments, opinions, or other conclusions. The law allows no appeal from or writ of error to review a decision of the Commission denying or awarding reparation for an alleged violation of the act. In an action to enforce a reparation order based on a discriminating freight rate, the question of the reasonableness of the rate is for the jury and not the court. Western New York & Pennsylvania R. Co. vs. Penn Refining Co., 137 Federal Rep. 343

Jurisdiction to Enforce Telegraph Right of Way Contracts.—In a suit to enforce telegraph right of way contracts with consolidated railroad companies the necessary parties being subject to the court's jurisdiction, it is not material that a portion of the property affected is beyond the court's territorial jurisdiction. Western Union Tel. Co. vs. Pittsburg, C., C. & St. L. Ry. Co., 137 Federal Rep. 435.

The Consulting Bridge Engineer.*

The practice of having the designs of bridges and other structures made by engineers employed by the purchaser, and letting the contract to a manufacturer on a pound-price basis is now becoming the standard practice of the country. Most of the large railroads have their own bridge and structural departments, or, for work of unusual magnitude, employ outside experts to design and supervise construction. Only a few of the smallest railroads adhere to the ancient practice of inviting manufacturers to submit competitive designs accompanied by a lump-sum bid.

The competitive system has had its day and has served a good purpose. It has been an important factor in developing the art of bridge building in America. It has been productive of establishing rational types, practical and scientific proportions; it has united theory and practice. However, at present, it is fast becoming a thing of the past. What is left of this practice is mostly confined to bridges for electric railways and light structural work. Many purchasers of structural work, who have had no experience themselves, do not seek professional advice, as they would in other cases where large expenditures of money are involved, believing that they can save the money paid for professional services by inviting manufacturers to make competitive designs accompanied by a lump-sum bid. The fact is, however, that the manufacturer has to pay for making the designs not only once, but many times over, as only once in a number of cases he is the successful bidder. The manufacturer will naturally add this extra expense to the cost of the structure, yet the designs are not made in the interest of the purchaser, but in that of the manufacturer. This practice has a demoralizing influence, as it puts a premium on the poorest design and tends to decrease the professional standard of an important branch of engineering.

The standard practice to be recommended, as the only fair and business-like method, is to let contracts for structural steelwork on a pound-price basis, on designs and specifications furnished by an experienced engineer employed by the purchaser. This method is fair to the honest manufacturer, as all competitors bid on the same basis; it is an advantage to the purchaser, as he employs the engineer who will protect his interests, study the conditions and requirements, and design a structure to suit the needs of his client. It will benefit a number of engineers, who are now compelled to waste their time and energies in making speculative designs to suit the commercial interests of a manufacturer, regardless of good practice, by elevating them to more independent positions, thus enabling them to raise their professional standards to the highest ideals of good practice.

Plans for bridges and other structures, on the safety of which the lives of human beings depend, should be designed and not manufactured; their design and the supervision of their construction should be entrusted only to competent engineers, who, besides the requisite theoretical and practical knowledge, should, above all, be endowed with common sense and good practical judgment.

Most of the largest bridges and other steel structures which have been built in later years have been designed by engineers not connected with manufacturing establishments. The manufacturer should confine himself to his legitimate field of manufacturing structural steelwork at so much a pound. The line between engineers and manufacturers will be even more marked in the future, when the same distinction will prevail as now exists between the architect and the contractor. The manufacturers of structural work, in the future, will devote their energies to improvements in their tools and machinery and methods for handling material. Their engineering force will consist of mechanical experts, shop draftsmen and engineers, who, with a thorough knowledge of shop practice, are skilled in putting the engineers' designs into convenient shape for the workshop.

*Extract from the annual address of Mr. C. C. Schneider, President of the American Society of Civil Engineers.

Train Accidents in the United States in May.[1]

unx, 1st, Baltimore & Ohio, Valley Falls, W. Va., a freight train was derailed and the engine and several cars were badly wrecked. The engineman was killed and two other trainmen were injured.

unx, 1st, Chicago, Milwaukee & St. Paul, Ottumwa, Iowa, a westbound passenger train was derailed on a curve; engineman killed, fireman injured.

o, 4th, Baltimore & Ohio, DeForest, Ohio, the locomotive of a freight train was wrecked by the explosion of its boiler; the fireman was killed and the engineman and one brakeman injured.

unx, 6th, Louisville & Nashville, Sulphur, Ky., passenger train No. 7 was derailed on a curve and the engine was overturned and the mail car wrecked. The engineman was killed and two passengers and four postal clerks were injured.

*unx, 6th, 11 p.m., Galveston, Houston & Northern, Harrisburg,

[1]Accidents in which injuries are few or slight and the money loss is apparently small, will, as a rule, be omitted from this list. The official accident record, published by the Interstate Commerce Commission quarterly, is regularly reprinted in the *Railroad Gazette*. The classification of the accidents in the present list is indicated by the use of the following

ABBREVIATIONS.

rc	Rear collisions.
bc	Butting collisions.
xc	Miscellaneous collisions.
dr	Derailments; defect of roadway.
eq	Derailments; defect of equipment.
dn	Derailments; negligence in operating.
unf	Derailments; unforeseen obstruction.
unx	Derailments; unexplained.
o	Miscellaneous accidents.

An asterisk at the beginning of a paragraph indicates a wreck wholly or partly destroyed by fire; a dagger indicates an accident causing the death of one or more persons.

Tex., a passenger train was derailed and the engine and seven cars were overturned. The tender was broken open and the fuel oil contained in it was spread over the wreck, which took fire instantly and was entirely consumed. The engineman and fireman were killed and their bodies were burnt up.

unx, 9th, Gulf & Ship Island, Laurel, Miss., a car in a freight train was derailed and, running on to a trestle bridge while off the track, broke through; and, with two other cars, fell to the ravine below. One brakeman was killed.

unx, 10th, Southern Railway, Lockhart, S. C., a mixed train was derailed and the cars fell down a bank. Two men were killed and a third was injured.

*†11th, 1 a.m., Pennsylvania road, at Lochiel, Pa., two miles east of Harrisburg, two cars of an eastbound freight train were derailed and were pushed to one side so as to foul a westbound passenger track. A westbound passenger train ran into the derailed cars, one of which contained blasting powder, and there was at once a terrible explosion, killing or fatally injuring 20 passengers and three employees, and injuring 109 other passengers and three employees. The passenger train was second No. 19 westbound. The freight, eastbound, consisting of engine, tender and 68 cars, with 34 cars air-braked, was stopped by a flagman protecting a switching engine, which was occupying the main eastbound freight track; and the application of the air-brakes on the first 34 cars caused two cars, the 35th and 36th, to "buckle." The 36th car, loaded with Judson powder, was forced to one side so as to partially foul the westbound passenger track. The engine and first three or four cars of the passenger train passed the derailed freight cars without great damage, though it appears that the shock was sufficient to awaken all the passengers in the sleeping cars and to do considerable damage to the engine and first two or three cars of the train. The engineman of the passenger train was probably killed at this time. Immediately after the first shock and the passenger train having come to a stop, there were two minor explosions, caused by some of the scattered powder being ignited by the fire from the engine. This was followed very closely by a very heavy explosion, caused by the entire lot of powder becoming ignited. There is no truth in the report that the locomotive boiler exploded. The engine was repaired and was put in service in three days. All the cars appear to have been set on fire at once by the explosion and survivors describe the spread of the flames as very rapid. Many of the surviving passengers were burnt and many were cut by broken glass. The Coroner's jury found that the railroad company and its employees were not guilty of any negligence by reason of which the accident occurred; that the rules of the company in regard to the flagging of trains and the stoppage of trains were strictly observed, and "the company and its employees are to be commended for their actions after the accident in taking care of the wounded and distressed." This accident was reported in the *Railroad Gazette* of May 19 and was discussed in the issue of June 2.

bc, 11th, Pennsylvania road, Warren, Pa., butting collision between an empty engine westbound and two engines coupled together eastbound. Two of the engines were wrecked. One fireman was killed, one engineman fatally injured and two other men badly scalded. It is said that the two freight engines had been delayed by an accident to the machinery of one of them, and that the men in charge failed to properly protect their train.

unx, 11th, Southern Railway, Knoxville, Tenn., several cars in a freight train were derailed and ran against a watchman's cabin. A policeman in the cabin was killed and the watchman was injured.

unx, 11th, St. Louis, Iron Mountain & Southern, Tillar, Ark., a freight train was derailed and six cars were wrecked. A brakeman was killed and two trespassers riding in one of the cars were injured.

12th, St. Louis Southwestern, Weaver, Tex., a passenger train was derailed on or near a small bridge which had been weakened by a flood and the engine and five cars were overturned. Five trainmen were injured.

xc, 12th, Chicago & North-Western, Chicago, Ill., an empty engine moving east, backward, ran over a misplaced switch and into the side of a car in a passenger train moving westward, badly damaging one car. Seven passengers were injured.

xc, 12th, 8 p.m., St. Louis & San Francisco, Kansas City, Mo., a southbound passenger train collided with some freight cars which had accidentally run onto the main track, and the engine was overturned. The mail car was wrecked and the passenger cars much damaged. Three trainmen and four passengers were injured, one of the trainmen fatally.

unf, 12th, Weatherford, Mineral Wells & North-Western, Weatherford, Tex., a passenger train broke through a bridge which had been weakened by a flood and two passenger cars fell into Dry Creek; 20 passengers were injured. It is said that the trestle was knocked out of line by a log, which floated against it just before the train approached.

bc, 13th, Pennsylvania road, Hyde Town, Pa., butting collision of freight trains, wrecking both engines and 12 cars. One engineman and one fireman were killed and several freight trainmen were injured.

unx, 14th, Gulf & Ship Island, Lumberton, Miss., a passenger train was derailed and the rear coach was overturned. Five passengers were injured.

unf, 14th, Atchison, Topeka & Santa Fe, Emporia, Kan., a passenger train was derailed at a point where the rails had been maliciously loosened, and five cars were ditched, most of them being wrecked. Six passengers were injured, two probably fatally.

dn, 15th, Cleveland, Cincinnati, Chicago & St. Louis, Otterbein, Ind., passenger train No. 11 was derailed at a misplaced switch and the engineman and fireman were killed; three passengers and two mail clerks were injured.

unx, 15th, Long Island road, Woodhaven, N. Y., the locomotive of a passenger train was derailed at a switch and was overturned. The passenger cars were considerably damaged and 12 or more passengers were injured.

o, 15th, Pennsylvania road, Leaman Place, Pa., the locomotive of a freight train was wrecked by the explosion of its boiler. The fireman was fatally scalded; but the engineman, who was hurled into a ditch with the cab, escaped with slight injuries.

dn, 15th, 8 p.m., Southern Railway, Flovilla, Ga., passenger train No. 9 was derailed at a misplaced switch; the fireman was killed and two other trainmen were injured.

xc, 17th, Lake Shore & Michigan Southern, Buffalo, N. Y., collision between a passenger train and two yard engines; one fireman killed.

unx, 17th, St. Louis & San Francisco, Francis, Ind. T., a northbound passenger train was derailed and the first three cars were wrecked. Four trainmen were injured.

bc, 18th, Illinois Central, Echols, Ky., butting collision of freight trains, making a bad wreck; seven trainmen were killed and one trainman and two passengers were injured. It is said that the collision was due to an error in reading the time in a telegraphic order.

dn, 19th, Norfolk & Western, Mackey's Ferry, N. C., a mixed train was derailed at a misplaced switch and the engine and two freight cars were wrecked. A brakeman was killed and several other persons were injured.

unf, 19th, St. Louis & San Francisco, Kosoma, Ind. T., northbound passenger train No. 2 was derailed on a bridge and the engine and first three cars broke through the bridge. Four trainmen and 11 passengers were injured. It is said that the derailment was due to the weakening of the bridge by a flood.

unx, 19th, St. Louis & San Francisco, Lamar, Mo., three cars of a freight train were derailed and ditched, and two tramps were killed.

unx, 22d, Cleveland, Cincinnati, Chicago & St. Louis, Sidney, Ohio, a freight train, made up entirely of new cars, was derailed while running at high speed, and 14 cars were wrecked. A woman walking near the track was killed.

unf, 23d, 4 a.m., Louisville & Nashville, Columbia, Tenn., passenger train No. 1 was derailed at a washout, and two sleeping cars fell down a bank and were submerged in 7 ft. of water. Eight passengers were injured.

xc, 24th, Atchison, Topeka & Santa Fe, Hutchinson, Kan., a passenger train collided with a string of freight cars. One mail clerk was killed and the engineman, fireman and five other persons were injured, the engineman and fireman probably fatally.

bc, 25th, Augusta, Ga., collision between a freight of the Charleston & Western Carolina and a switching train of the Central of Georgia, badly damaging both engines; a brakeman was killed.

bc, 27th, 5 a.m., Louisville & Nashville, Madisonville, Ky., butting collision between a freight train and a work train, wrecking both engines and many cars. One fireman was killed and two other trainmen were injured.

unx, 28th, Texas & Pacific, Keithville, La., westbound passenger train No. 51 was derailed and the engine and baggage car were overturned. Two trainmen and two passengers were injured.

unx, 29th, Pennsylvania Lines, Bloomville, Ohio, the rear car of a passenger train was derailed and ran against a hand-car loaded with ties. A workman near the hand car was killed and two others were injured.

xc, 30th, Galveston, Harrisburg & San Antonio, Sartartia, Tex., a passenger train of the Missouri, Kansas & Texas collided with a freight train which was entering a side track, wrecking three cars. A roadmaster who was riding on the engine, acting as pilot of the train, was severely injured, and the fireman less severely.

xc, 31st, 2 a.m., Seaboard Air Line, Fairfax, S. C., passenger train No. 66 collided with some freight cars which had escaped control and run from a siding to the main track, and the engine and mail car were wrecked. Three trainmen were injured.

xc, 31st, Pennsylvania Lines, Sheridan, Pa., a freight train ascending a grade broke in two and the rear portion ran back into the head of a following passenger train, wrecking the caboose and one car and damaging the engine. One passenger and two trainmen were injured.

unx, 31st, 6 a.m., Texas & New Orleans, Mabank, Tex., a mixed train running backward was derailed and the engineman and fireman were injured, the latter probably fatally.

GENERAL NEWS SECTION

NOTES.

The Railway Commission of Canada has appointed two inspectors to examine into the conduct of the railroads generally and to make weekly reports; the principal object being, according to the reports, "to secure compliance with those provisions of the railroad law designed to insure safety."

A Massachusetts manufacturer in a complaint to the Springfield *Republican* says that the tipping or bribing evil now makes trouble in the freight department. When two shippers send freight to New York (by boat) or to points beyond New York, if the boys at the dock have been "fixed" the goods arrive in 24 hours; if not, maybe in ten days.

A correspondent in central Illinois who appears to be somewhat startled by the strenuousness now visible in certain departments of the Wabash, summarizes his observations as follows: "The new general manager of the Wabash, in his policy of retrenchment has since the middle of June abolished all train collectors; consolidated the road's six divisions into three; consolidated under one head the locomotive, car and machinery departments; taken off half the through and many accommodation trains; consolidated maintenance of way departments of the Springfield and Middle, and Detroit and Eastern, divisions; abolished pay cars, paying employees by checks sent to heads of departments and agents; and reorganized the purchasing department, creating a general head for all Wabash properties."

In the complaint of Wylie against the Northern Pacific, the Interstate Commerce Commission, in an opinion by Chairman Knapp, decides that the Northern Pacific has no right to make through passenger rates with stage lines to the Yellowstone Park which discriminate in favor of a certain stage line and a certain hotel company. The complainant runs a stage line in opposition to the one favored by the railroad. The road had sold through tickets on which it received less than its established rate to the nearest railroad station. The railroad company controls the policy and operations of these stage and hotel companies which it favors. The commission holds that the stage company is not competent in law to be a party to through routes and joint rates, as contemplated by the Interstate Commerce law.

At Kansas City, July 1, papers were filed in the United States District Court in the suit of the Government to punish the Atchison, Topeka & Santa Fe for contempt of court in giving secret reduced rates to the Colorado Fuel & Iron Company. This suit is based on the evidence taken by the Interstate Commerce Commission and published in the decision of that body several months ago. The special counsel engaged by the department of justice to decide what action should be taken by the Government in this matter recommended that officers of the road be charged with contempt and be called to answer; but President Roosevelt decided that only the company should be prosecuted; that to prosecute the officers, one of whom was Paul Morton, Vice-President of the company at the time the offences were committed and since then Secretary of the Navy, would be unjust, because in dealing with other corporate offenders against the laws—notably the Harvester Company at Chicago—the Government had not prosecuted individuals.

The Secretary of Agriculture is preparing 1,200 suits against railroads for violation of the law limiting the time which animals may be confined in cars in transportation. It is said at the Department that the law has heretofore been a dead letter because the railroads which have been prosecuted have simply paid their fines and gone on with the violations as before; but evidence has now been secured under which very many flagrant violations can be punished. Since the department began its inquiries a number of railroads have taken action to comply with the law. The Missouri Pacific has quickened the time of one run from 47 hours to 27. The Chicago & North-Western proposes to use stable cars (exclusively?), and if the animals are made comfortable in these cars the Government will not prosecute. The Illinois Central has established extensive feed and rest yards at Freeport. It is said that the railroads will try next winter to induce Congress to repeal the law or to allow animals to be confined more than 28 hours.

A Transatlantic Tow.

The Standard Oil Company has for some time brought much of its crude oil from the Texas fields to the New York refineries in steel barges, towed by steamers specially built for this work. The newer barges carry 50,000 bbls. (say 8,000 tons) of oil, and the steamer carries 30,000 to 40,000 bbls. additional. The refined oil shipped to European ports has never been carried in barges, however, but in tank steamers with a capacity of from 40,000 to 70,000 bbls. Announcement has just been made that the towing steamer Col. E. L. Drake has started across the ocean to London with barge 95. Although this is the first transatlantic tow of oil, it is not the record haul, for the S. O. steamer Atlas took a barge from New York to San Francisco, last winter, covering 13,090 miles in 72 days.

Michigan Refrigeration Cases.

The Interstate Commerce Commission, in an opinion by Commissioner Prouty, has announced its decision concerning refrigeration of fruit on the Pere Marquette and Michigan Central roads. It is held that railroad companies are required at common law to furnish suitable transportation facilities, and it follows that the railroad companies in this case, holding themselves out as common carriers of perishable fruit, must provide the necessary refrigerator cars for the traffic; that during the performance of the transportation the car is the car of the railroad company using it, and its measure of responsibility as to the sufficiency of the car is the same, whether it obtains the car by purchase or lease; that a railroad company holding itself out as a carrier of a commodity which can only move under refrigeration is ordinarily in duty bound to furnish that refrigeration, for the icing is not a mere incident of the transportation service but is a part of the service itself; that refrigeration, being incumbent upon the carrier as a part of the transportation, the charge for that service stands like any other charge for transportation, and it is the duty of the carrier to publish, file with the Commission, and observe its refrigeration charges, over which the Commission has the same jurisdiction as of any other charge for transportation; that it is not within the province of the Commission to prescribe the method or kind of refrigeration charges which shall be adopted by the carrier. The Commission finds that a reasonable refrigeration charge based upon the cost of the ice actually used would be $2.50 per ton. The Michigan Central has established for the present season the reasonable charge of $2.50 per ton for ice actually used, and that company should be dismissed. The Pere Marquette, while under contract to continue its use of Armour cars during the present season, has made reductions in its refrigeration charges amounting to from 15 to 30 per cent. to apply during the present season, and has filed a statement with the Commission that it intends for the season of 1906 to purchase or lease its own equipment and also furnish refrigeration at $2.50 per ton for the ice actually used in transit. For various reasons stated by the Commission, including the consideration that the Commission is without authority to fix rates for the future, no order is issued at this time.

Grab Irons in Texas.

The General Managers' Association of Texas has given notice of a resolution recently adopted that after June 1, 1906, the lines in the Association will not accept cars for transportation or switching purposes, owned by other railroad companies, private car lines or individuals, with hand-holds and foot-holds secured by lag screws, except with the understanding that if any such car is received the lag screws will be replaced by bolts, at the expense of the owner. Cars will only be acceptable, in this respect, after the substitution of bolts for lag screws, when hand-holds and foot-holds are secured by bolts nutted, with ends of same upset to keep the nut from turning off or being screwed off. C. Hamilton, of Waco, is President of the Association.

Differential Fares by the Michigan Central.

The Michigan Central recently asked the authority of the Central Passenger Association to sell tickets at the differential rate ($2 less than standard) from Chicago to the seaboard. The matter was referred to three arbitrators, and they decided that the privilege should be granted. When it was found that the Michigan Central interpreted this decision as allowing it to sell at the differential rate over the New York Central, a standard line, the other roads objected. In view of this objection, the arbitrators have issued a supplementary opinion stating that the decision was understood to apply to the New York Central as well as to any connection on which differential fares are accepted. There has been strenuous objection made by the Grand Trunk to the granting of this privilege to the Michigan Central, and the Grand Trunk has declared that it will reduce its rates so as to preserve its differential under the Michigan Central's rate. The Pennsylvania offers a similar dif-

ferential rate by the Pittsburg, Cincinnati, Chicago & St. Louis, whose passengers go over the standard Pennsylvania line east of Pittsburg.

Safety on the Lake Shore.

The Lake Shore & Michigan Southern has ordered the removal within ten days of all facing point switches on the main line between Chicago and Buffalo; or, where removal is impossible, the protection of such switches by distant signals. According to a press despatch, special watchmen have been stationed to see that unprotected switches are right before the arrival of the 18-hour express trains, the watchmen to remain at the switches until the train passes.

New Zealand Railroads.

The railroads of New Zealand, with the exception of one private line 84 miles long, all belong to the state. There are about 2,374 miles in operation on a 3-ft. 6-in. gage. Including the steamer service on Lake Wakatipu, they represent a capital expenditure of about $100,000,000. A few years ago, a number of American locomotives and cars were imported by the government; but, on account of local criticism of the policy of importing from abroad, the government workshops have recently been largely employed in building additional rolling stock to meet the rapid increases in traffic. During the year ended March 31, 1904, there was an increase of five locomotives, 58 passenger cars, 18 brake vans, and 423 freight cars in the equipment. At the same time, there were being built 21 locomotives, 11 of them in government workshops. The total rolling stock in use at the end of the year was 377 locomotives, with an average tractive power of 9,476 lbs.; 809 passenger cars, with an average seating capacity of 39½ persons, and 13,132 freight cars, with an average capacity of seven tons. At the best equipped shops in the colony, where about 450 men are employed, an engine has been turned out in five weeks. Within the last few years, Westinghouse air-brakes and Pintsch gas have been very largely introduced, as well as the interlocking system, and the electric-tablet system of train signaling, which are in use over a considerable mileage and are being rapidly extended. During the year under review, 58 miles of track were relaid with 70-lb. rails, and it was proposed to relay at least 100 miles more during the year ended March 31, 1905.—*London Times.*

Duff Roller Bearing Screw Jacks.

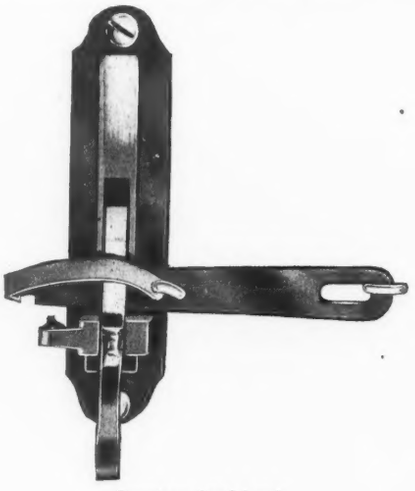
The Duff Manufacturing Company, Pittsburg, Pa., has placed on the market a new line of roller bearing screw jacks in 25 or more different sizes. These jacks have been put to abnormal tests in order to prove their efficiency for heavy work, and have demonstrated a considerable saving in operating expenses and in time and labor. The makers claim that the same load can be raised about 15 per cent. easier with the "Duff" jack than with any other anti-friction screw jack.

The "Duff" jack contains two roller bearings—one large or main bearing at the head of the jack, and another bearing to take the thrust on the bevel pinion. The main feature of any anti-friction jack, however, is the bearing itself. The roller bearing used is a patented bearing consisting of two hardened ground tool steel plates with a cage between them carrying the hardened ground rolls. A cut of the two bearings employed is shown herewith. It is claimed that this form of bearing will stand heavier loads, and will wear better than ball-bearings, and that the rolls will not crush or flatten and will not wear grooves in the hardened plates after continuous service, as is often found in other types of anti-friction bearings. When the bearings are removed from the jack frame, they remain intact and do not separate and become hard to handle.

The ratchet on the "Duff" jacks is of special construction, and with it the jack may be reversed with ease and quickness. The "Duff" roller bearing jacks cover a wide field in the handling of railway equipment, in bridge work and in the way of wrecking purposes. They are made in all sizes with capacity from 15 tons to 70 tons. Cone bearing and roller bearing journal jacks with capacities of 10, 15 and 25 tons are also made by this company.

The Preston Seal-Lock.

The accompanying illustration shows the Preston seal-lock. The patents are owned by Crago & Bohrnstedt, Cadott, Wis., who describe the device as follows: The seal is made of very thin tin with a hole in each end. No leading of any kind is necessary, which reduces the cost of seals very materially. The locking device is secured by a retaining guide in the form of a lug having forwardly projecting flanges, and through the medium of a dog engaging one of a series of serrations. The hasp is provided with a diamond point and a knife hook, which hold the seal in position and help

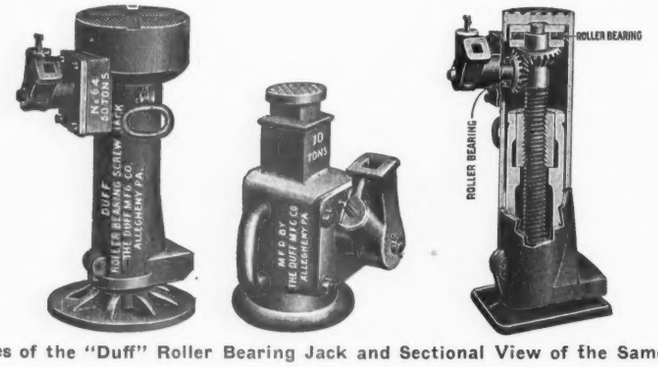


Preston Seal-Lock.

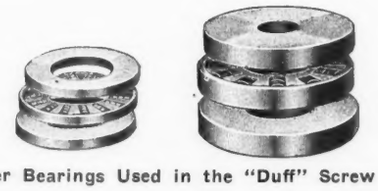
to mutilate it when the locking device is forced upward. The locking device is also provided with a sharp edge which cuts the seal in two pieces when the lock is opened. No sealing punch is required to close the seal, and the latter is destroyed when the lock is opened, making it impossible to use it a second time. The lock is easily opened with the hand and is operated quickly. It is also provided with openings which will admit of the use of any seal now on the market. The lock was on exhibition at the International Railway Congress at Washington in May.

Suez Canal Traffic.

The net tonnage through the Suez Canal in 1904 shows an increase of 1,494,547 tons compared with that of 1903, the increase being due to heavy shipments of wheat from India to Europe, and to the large quantities of coal consigned to the East. The latter exceeded the shipments of 1903 by about 500,000 tons. During the year 4,237 vessels passed through the canal, of which 2,679 were British. There was an increase in 1904 of 1,430,376 tons in the tonnage of British vessels as compared with 1903. The figures were 7,403,553 tons in 1903 and 8,833,829 tons in 1904. The tonnage of German vessels increased from 1,773,265 tons in 1903 to 1,969,561 tons in 1904. In the year 1870, when the canal was opened, 26,758 civil and military passengers were carried through the canal; in 1904 the number was 210,849.—*Consular Report.*



Types of the "Duff" Roller Bearing Jack and Sectional View of the Same.



Roller Bearings Used in the "Duff" Screw Jacks.

The Milan Exhibition of 1906.

To celebrate the inauguration of the Simplon tunnel, an exhibition is to be held at Milan, in 1906, under the patronage of the King of Italy. It is known as the International Exhibition of Public Hygiene and Hygiene and Sanitary Assistance in Transports, and the programme indicates that special attention will be paid to the hygiene of railroad buildings and rolling stock, organization of railroad emergency services, etc.

Engineering Societies of the World.

The following statistics of the principal engineering societies were recently given by John W. Leib, Jr., in his presidential address before the American Institute of Electrical Engineers:

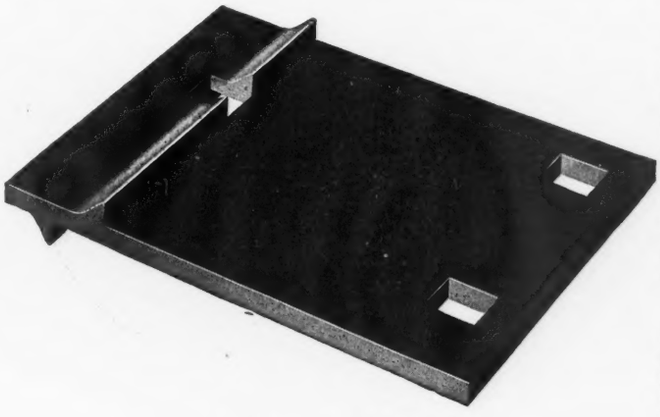
Name and date of organization.	Date of report.	Honorary members.	Full members.	Associate members.	Associates.	Junior members.	Total.
Am. Society of Civil Engineers, 1852.	1905	9	1,795	903	127	367[1]	3,203
Am. Inst. of Mining Engineers, 1871.	1905	7	3,483	...	190	...	3,680
Am. Society of Mech. Engineers, 1880.	1905	19	1,915	...	237	609	2,780
Am. Inst. of Electrical Engineers, 1884	1905	2	481	2,851	...	...	3,334

Name and date of organization.	Date of report.	Honorary members.	Full members.	Associate members.	Associates.	Total.
Instn. Civil Engrs. (Great Britain), 1818	1905	19	2,191	4,110	271	6,597[2]
Instn. of Mechanical Engineers, 1847.	1905	9	2,351	1,454	72	3,977[3]
Iron and Steel Inst., 1869.	1905	11	1,898	.....	.....	1,909
[4]Instn. of Electrical Engineers, 1889.	1904	6	1,101[5]	1,435	1,761	4,303[6]
Verein Deutscher Ingenieure, 1891.	1903	6	17,543	.....	.....	17,549
Société des Ingénieurs Civil de France, 1848	1901	..	.....	.....	.....	3,691

[1]Includes 27 Fellows.
[2]Includes 136 Foreign Members.
[3]Not including 1,144 students or graduates.
[4]Originally organized as the Society of Telegraph Engineers and Electricians in 1871.
[5]Not including 450 students or graduates.
[6]Not including 1,107 students or graduates.

"Combination" Tie Plate.

The tie plate shown herewith is a new one, recently added to the line of the Railroad Supply Co., Chicago, and called the "Combination." It has a rib on each side. One acts as a shoulder to prevent lateral movement of the rail. The lower rib enters the tie



Combination Tie Plate.

to prevent displacement of the plate by the downward and outward thrust of the rail. It is called a "combination" tie plate because it can be used either under a rail joint or at intermediate points simply by reversing it, the shoulder in either case supporting the rail.

Additional Panama Steamer.

The Panama Railroad Steamship Line has chartered the Savannah Line steamer "City of Savannah" for a term of three months, with an option for renewal or of purchasing the boat if she proves satisfactory. The "City of Savannah" was built in 1896 by the Newport News Shipbuilding & Dry Dock Company for the Plant Steamship Company, and was originally named "La Grande Duchesse," until purchased by the Savannah Line. She is a twin screw boat, 380 ft. long, 47 ft. beam and 28 ft. deep and of 5,017 tons gross register. Her engines are of 6,500 i.h.p. Built for a 16½ knot ship, her record has been unsatisfactory, in speed performance and coal consumption, and she has a comparatively small cargo space.

The German Technolexicon.

Dr. Hubert Jansen, editor-in-chief of *The Technolexicon*, which is being published by the Society of German Engineers, announces that in the compilation of this universal technical dictionary for translation purposes—which is being prepared in English, German and French, and was commenced in 1901—about 2,000 firms and individual collaborators are at present assisting. At the present time 2,700,000 word cards have been collected. For further particulars Dr. Jansen may be addressed at 49 Dorotheenstrasse, Berlin.

The Acrobat versus the Street Car.

At a recent meeting of insurance men with a view to starting a campaign against hired witnesses, shyster lawyers, ambulance chasers and professional accident claimants, Theodore Waters showed a photograph of an acrobat who had evolved a somewhat hazardous method of making a living. "This man," said Mr. Waters, "didn't mind letting street cars bump him all over the street. He would be picked up by a confederate and carried to a furnished room. Then the confederate would be bandaged up and the acrobat would go out again to get bumped. Again a confederate would go to bed with the injuries the acrobat was supposed to have received. Getting witnesses was easy. The gang had little trouble in collecting damages. Finally they were caught and punished."

Dominion Mail Subsidies.

The State Department has made public the information that in the fiscal year ended June 30, 1904, the Canadian Government paid $851,748 in mail subsidies to steamship lines. The largest amount, $175,000, was paid to lines running from Canada to Great Britain; $146,000 was paid to the Canada-South African lines, and $116,800 to the Australian lines.

Manufacturing and Business.

The Railway Steel-Spring Co., it is said, will enlarge its car-wheel shops at Hudson, N. Y.

The Buda Foundry & Manufacturing Co., Chicago, has shipped 98 push cars to Panama, this being part of a large order for various track construction supplies received recently.

According to reports from Philadelphia, the Philadelphia & Western has decided to use the third-rail system, and a contract is to be given at once for building an electric generating plant.

The Philadelphia & Reading has given a contract to Robert Palmer & Sons Shipbuilding Co., of Noank, Conn., for building six coal barges, each of which will have a capacity of 1,200 tons, to be completed during the coming fall and winter.

W. A. Stadelman, eastern agent of the Wellman-Seaver-Morgan Company, and who has been in charge of the eastern office at 42 Broadway, New York, has been appointed general sales agent of the same company, with headquarters at Cleveland, Ohio, taking effect July 1. Fred Stadelman has been appointed assistant manager of the New York office.

The Isthmian Canal Commission have ordered 3,000 squares of Paroid roofing and a similar amount of Neponset black building paper and Neponset insulating paper from F. W. Bird & Son, East Walpole, Mass. The above company state that the Government has used many carloads of Paroid in the Philippines, Cuba, and on work in this country.

The Toledo-Massillon Bridge Co., recently formed by the reorganization of the Massillon Bridge Co., has selected a site for its new works at Toledo. Plans now being made call for a main building 100 x 400 ft. of brick construction, to contain traveling electric cranes and a large amount of machinery. There will also be five smaller buildings, and it is expected to have the works in operation by the first of next month.

J. G. White & Co., of New York, announce the appointment of Mr. Harold U. Wallace, the son of John F. Wallace, as Third Vice-President of their company. Mr. Wallace was Chief Engineer of the Illinois Central up to March of this year. He has been connected with the Illinois Central since 1894, having been Chief Engineer since 1902. The lake front improvement work of the road in Chicago, which included the depression and reconstruction of 20 miles of yard and main tracks, was carried out under the supervision of Mr. Wallace.

Iron and Steel.

The Tennessee Coal, Iron & Railroad Co. has recently received an order for about 55,000 tons of rails for 1906 delivery.

Bids will soon be asked for about 55,000 tons of steel to be used in building the new Manhattan bridge over the East river, New York.

The Pittsburg Steel Co. has given an order to the United States Steel Corporation for 1,000,000 tons of steel billets for delivery within the next five years.

The American Bridge Co. and Riter-Conley Manufacturing Co., of Pittsburg, have the contract for the 10,500 tons of structural steel to be used in the new buildings at the West Allis plant of the Allis-Chalmers Co.

The Lake Shore & Michigan Southern has given a contract for about 15,000 tons of bridge material to be used in building small

structures along the line of its road and the Atchison, Topeka & Santa Fe has given an additional order for 3,000 tons.

Orders have recently been given by the Vanderbilt roads for 25,000 tons of rails; by the Wabash, 5,000 tons; Toledo & Chicago Interurban, 5,500; Long Island, 2,500; electric roads in the neighborhood of Cleveland, 5,000; electric lines in the east, 10,000 tons.

MEETINGS AND ANNOUNCEMENTS.

(For dates of conventions and regular meetings of railroad conventions and engineering societies, see advertising page 24.)

National Railroad Master Blacksmiths' Association.

The next meeting of this association is to be held August 15, 16 and 17 at Cleveland, with headquarters at the Forest City House (rate $2 a day). The following committee reports will be presented: "Forging Machine Formers, Bulldozers, Etc.," D. H. Edwards, Chairman; "Spring Making, Repairing and Tempering," Jas. Fenwick, Chairman; "Oil Furnaces," John McNally, Chairman; "Manipulating Tool Steel, Including High Speed Varieties," R. A. Mould, Chairman; "Tools and Formers for Steam Hammers," D. Fitzgerald, Chairman; "Best Material and Methods of Forging Motion Work," J. B. Anderson, Chairman; "Ideal Blacksmith Shop," H. G. Price, Chairman; "Best Methods of Repairing Locomotive Frames, Both Iron and Steel," W. Smith, Chairman; "Best Methods of Testing Materials and Selecting Same for Uses Intended," L. J. Brunner, Chairman.

PERSONAL.

—Mr. J. L. Campbell, who has been appointed Engineer of Maintenance of Way on the El Paso & Southwestern and the El Paso-Northeastern System, was born in 1863 and began railroad work in 1894 as Resident Engineer of Construction on the Rio Grande Northern Railroad of Texas. From 1895 to 1898 he was Locating Engineer for the Rio Grande, Sierra Madre & Pacific. In 1897 he was made Chief Engineer of Location and Construction on the El Paso-Northeastern, and subsequently served on the Atchison, the Arizona & New Mexico, part of the Southern Pacific, and the St. Louis, Kansas City & Colorado. He next entered the service of Phelps, Dodge & Co. and was appointed Engineer of Maintenance of Way of the El Paso & Southwestern and the recently acquired El Paso-Northeastern. For the four years before he began railroad work Mr. Campbell was Chief Engineer of the City of El Paso, Texas. He was in May, 1901, elected a member of the American Society of Civil Engineers.

—Honorable S. Parent, formerly Premier of the Province of Quebec, will, it is reported, be appointed to the Railroad Commission of the Privy Counsel, to succeed the Honorable F. B. Wade, deceased.

—Mr. Charles A. Dunham, who has been appointed Signal Engineer of the Great Northern, entered railroad service in 1884 on the Chicago, Burlington & Quincy as a helper in the mechanical department. In 1887 he went to the bridge department of the New York, Chicago & St. Louis. For some time he worked for Grant Brothers, railroad contractors in California, and in March, 1890, he re-entered the service of the Burlington as a locomotive fireman. In 1892 he left the Burlington to go to the Union Switch & Signal Company, for which company and the National Switch & Signal Company he worked until February, 1896, when he was appointed Inspector of Signals on the Illinois Central. He was soon made Supervisor of Signals, and on March 1, 1901, was promoted to be Signal Engineer.

—Hon. Fletcher Bath Wade, K. C., M. P., late Chairman of the Commissioners of the (Canadian) Trans-Continental Railway, who died on May 23, was born Sept. 9, 1852, at Granville, N. S. After studying for three years in a lawyer's office he was admitted to the bar at Halifax, N. S., in 1875. Mr. Wade was connected with many railroad, steamship, mining and other companies. In 1878 he was appointed Solicitor of the Nova Scotia, Nictaux & Atlantic Railroad. In 1888 he was in charge of financing the completion of the Nova Scotia Central and later was appointed Receiver and Manager, which position he held for six years. He was a promoter of the Halifax & South Western and the Middleton & Victoria Beach railroads, which have since been sold to the McKenzie & Mann interests. Mr. Wade has been an active supporter of the Liberal party since 1878.

—Mr. A. T. Hardin, who has just been appointed Assistant to the General Manager of the New York Central & Hudson River, was born in 1868 and entered railroad service at the age of 14 as an operator on the Richmond & Danville. After working for seven years as operator, agent and stenographer, he went to the University of South Carolina, where he graduated in 1894 in the civil engineering course. In that year, he entered the Maintenance of Way department of the Southern. In 1898 he came to the New York Central as supervisor, since which time he has been Division Engineer of the Eastern division, Engineer of Track and Engineer of Maintenance of Way. This last position he leaves to become Assistant to the General Manager.

—Mr. John Marcus Davis, who has been appointed Assistant General Superintendent of the new Central district of the Great Northern, was born in 1871. His first railroad work was in 1889 as a brakeman on the San Antonio & Aransas Pass. From this he went into office work and served on the Gulf, Colorado & Santa Fe, the Mexican Central, and the Great Northern. In 1898 he was appointed Assistant Superintendent of the Fergus division of the G. N. He was transferred to the Montana division, and then back to the Breckenridge division. In 1900 he left the Great Northern to go to the Erie & Wyoming Valley; and thence went to the Erie as Superintendent of the Wyoming and Jefferson divisions. In 1902 he was transferred to the Allegheny division, and in 1903 returned to the Great Northern as Superintendent of the Eastern division. In 1904 he went to the Dakota division, and this year was appointed Superintendent of the new Minot division, which position he held until July 1, when he was appointed Assistant General Superintendent.

—Mr. Herbert T. Herr, who has been appointed Acting General Superintendent of the Denver & Rio Grande, was born in Denver in 1876. After graduating at the East Denver high school in 1895, he entered the shops of the Chicago & North-Western as an apprentice. After a year of this work, he went to Yale and graduated in 1899 from the Sheffield Scientific School. During two of the summer vacations while he was in college, Mr. Herr worked as apprentice on the Denver & Rio Grande. In 1899 he was appointed Division Master Mechanic of the Southwest division of the Chicago Great Western, and in December of the same year Mechanical Engineer. In April, 1902, he went to the Atchison, Topeka & Santa Fe as Master Mechanic at Fort Madison, Iowa. He next went to the Norfolk & Western as Master Mechanic of the Eastern division, with headquarters at Roanoke, Va. This position he held until September, 1904, when he was made Assistant to the Vice-President on the Denver & Rio

Grande, from which he is promoted to be Acting General Superintendent.

—Mr. Warren S. Palmer, who has been appointed General Superintendent of the Northern district of the Southern Pacific, comprising the Coast, Western, Sacramento and Carson & Colorado divisions of the Pacific system, is a native of San Francisco. He graduated in 1876 in the civil engineering course of the University of California. After his graduation, he served as carpenter and draftsman apprentice in the bridge and buildings department of the Central Pacific. In 1881 he was transferred to the engineering department, where he spent five years in location and construction work. In 1886 he left the railroad business to become a member of the firm of Palmer & Storey, engineers and contractors, during which time that firm built the Colusa & Lake, the Yreka and the Pajaro Valley railroads in California. In 1890 he returned to railroad service as Resident Engineer of the First district of the Southern Pacific, and in 1898 he was appointed Assistant Superintendent of the Western division. In 1901 he was appointed Superintendent of the Sacramento division, and a year later was transferred to the Western division. From this position he was recently promoted to be General Superintendent of the Northern district.

ELECTIONS AND APPOINTMENTS.

Atchison, Topeka & Santa Fe.—F. C. Fox, General Superintendent of the Western Grand Division, has been appointed General Superintendent of the Eastern Grand Division, with headquarters at Topeka, Kan., succeeding D. E. Cain, resigned. R. J. Parker, Superintendent of the Missouri division, has been appointed General Superintendent of the Western Grand Division, with headquarters at La Junta, Colo., succeeding Mr. Fox.

Chicago, Burlington & Quincy.—The Chicago division now includes the terminals and the main line to Clyde, Ill., seven miles. The Aurora division extends from Clyde to Galesburg, Ill., including the branch lines, except the line from Sterling to Deep Rock, which has been made part of the Galesburg division. The Galesburg division consists of the Quincy, Peoria, Galva, Keithsburg, Rushville, Tri-City and Savannah branches and the Galesburg yards. The Ottumwa division includes the main line from the West Galesburg yard to Creston, Iowa. The Burlington division is made up of the branch lines running into that city. It will also include the branch from Quincy, Ill., to Louisiana, Mo., which has been part of the Galesburg division. The St. Louis division extends from Rio, Ill., to St. Louis, including the branch from Concord via Jacksonville to Centralia.

L. N. Hopkins, Supply Agent of the lines East of the Missouri River, has been appointed Purchasing Agent of the Chicago, Burlington & Quincy, succeeding George G. Yeomans, resigned.

T. J. Frier, Assistant Supply Agent, has been appointed Supply Agent of the lines East of the Missouri river, with headquarters at Chicago, succeeding L. N. Hopkins, promoted.

Chicago, Rock Island & Pacific.—A. G. Merrill, Superintendent of of the Panhandle division, has been appointed Superintendent of the Arkansas division with headquarters at Little Rock. H. M. Hallock, Superintendent of the Oklahoma division, has been appointed to succeed Mr. Merrill, with headquarters at Oklahoma City, O. T.

Cincinnati, New Orleans & Texas Pacific.—D. M. Case has been appointed Superintendent of Signals of the Cincinnati, New Orleans & Texas Pacific, succeeding W. A. D. Short, who has resigned to become Signal Engineer of the Illinois Central.

C. E. Rickey has been appointed Superintendent of Car Service of the Cincinnati, New Orleans & Texas Pacific and Alabama Great Southern, succeeding I. F. Hall, assigned to other duties.

R. D. Lankford, Assistant Secretary, has been appointed Secretary of the Cincinnati, New Orleans & Texas Pacific, with headquarters at New York, succeeding W. A. Shoemaker, resigned. J. W. Hood has been appointed Assistant Secretary, with headquarters at Cincinnati, succeeding Mr. Lankford.

Delaware & Hudson.—George A Keller, Superintendent of Car Service, has been appointed Car Accountant, with headquarters at Albany, N. Y. He is succeeded by Thomas O. Cole, also with headquarters at Albany.

F. B. Lincoln, Superintendent of the Susquehanna division, with headquarters at Oneonta, N. Y., has resigned. The jurisdiction of A. T. Benjamin, Superintendent of the Saratoga division, with headquarters at Albany, has been extended over the Susquehanna division.

Denver & Rio Grande.—A. H. Calef, J. F. Vaile and W. H. Taylor have been elected directors. They succeed Edward O. Wolcott, deceased, and E. H. Harriman and Edwin Gould.

El Paso-Northeastern System.—Dennis Sullivan, General Superintendent, has resigned.

A. R. Oster has been appointed General Superintendent, with headquarters at Alamogordo, N. M., succeeding D. Sullivan, resigned.

Erie.—E. H. Harriman and George F. Baker, directors, have been elected to the executive committee.

Great Northern.—George S. Stewart, Assistant Superintendent of the Breckenridge division, has been appointed Superintendent of the Minot division, succeeding J. M. Davis, recently appointed Assistant General Superintendent.

R. D. Hawkins has been appointed General Master Mechanic of the Central district, with headquarters at Minot, N. Dak. The Central district, of which J. M. Davis was recently appointed Assistant General Superintendent, is a new general district and includes the Dakota, Minot and Montana divisions and the Montana Central Railway. The jurisdiction of the Assistant General Superintendent of the Eastern district has been extended to include the Willmar, Breckenridge, Fergus Falls and Northern divisions and the Willmar & Sioux Falls Railway. The jurisdiction of the Assistant General Superintendent of the Western district will include the Kalispell, Spokane and Cascade divisions and the Spokane Falls & Northern Railway.

Illinois Central.—T. J. Hudson, Traffic Manager, has been appointed General Traffic Manager; F. B. Bowes, Assistant Traffic Manager, has been appointed Freight Traffic Manager; A. H. Hanson, General Passenger Agent, has been appointed Passenger Traffic Manager, and S. G. Hatch, Assistant General Passenger Agent, has been appointed General Passenger Agent, succeeding Mr. Hanson. The offices of Traffic Manager and Assistant Traffic Manager have been abolished. The same appointments have been made for the Yazoo & Mississippi Valley.

Interborough Rapid Transit (New York).—George H. Pegram has been appointed Chief Engineer of the Interborough Rapid Transit Company and of the Rapid Transit Subway Construction Company, succeeding S. L. F. Deyo, Chief Engineer of the latter company and of the Subway division of the Interborough.

Kansas City Southern.—H. Visscher has been appointed Treasurer, succeeding F. V. S. Crosby, and R. J. McCarty, Auditor and Assistant Secretary, succeeding H. B. Johnson, resigned. Both will have headquarters at Kansas City.

New York Central & Hudson River.—A. T. Hardin, Engineer of Maintenance of Way, has been appointed Assistant to the General Manager.

George W. Vaughan, Division Engineer, has been transferred from Buffalo to the office of the Chief Engineer in New York in connection with terminal improvement work.

Newton & Northwestern.—Homer Loring, Treasurer, has been elected President, succeeding Hamilton Browne.

Pacific & Idaho Northern.—A. R. Randolph, Chief Claim Clerk of the Oregon Short Line, has been appointed General Superintendent, with headquarters at Weiser, Idaho.

Panama.—John F. Stevens has been appointed General Manager, succeeding John F. Wallace.

Peoria & Pekin Terminal.—George F. Newman has been appointed General Freight Agent.

St. Louis & San Francisco.—J. G. Taylor, Division Engineer of the Western division, has been appointed Resident Engineer of the Eastern, Central and Southwestern divisions with headquarters at Springfield, Mo. C. B. Spencer, Division Engineer of the Northern division, has been appointed Resident Engineer of the Northern and Western divisions with headquarters at Joplin, Mo. N. B. Hanna has been appointed Resident Engineer of the Southern division and of the Kansas City, Memphis & Birmingham, with headquarters at Memphis, Tenn. H. Hall, Assistant Division Engineer, has been appointed Assistant Resident Engineer of the River and Cape divisions, with headquarters at Cape Girardeau, Mo. All of the resident engineers will report to the Engineer of Maintenance of Way.

Southern.—Charles Hoffman, who has been Road Foreman of the locomotive department of the Chicago, Burlington & Quincy, has been appointed Master Mechanic of the St. Louis-Louisville Lines, with headquarters at Princeton, Ind.

Trinity & Brazos Valley.—Michael Sweeney is Vice-President as well as General Manager. R. H. Baker, who has been Vice-President and General Manager, continues as Vice-President.

Wabash.—James K. Howard, Engineer of Maintenance of Way of of the Western division, with headquarters at Peru, Ind., and Guy Courter, Assistant Engineer of Maintenance of Way of the Springfield division, with headquarters at Springfield, Ill., have resigned, the latter to go into private business. E. K. Woodward, Engineer of Maintenance of Way at Detroit, has been appointed to succeed Mr. Howard. A. G. Trippeer, Engineer of Maintenance of Way of the St. Louis division, with headquarters at Moberly, Mo., has been transferred to the Detroit division, succeeding Mr. Woodward. E. M. Merriweather, Engineer of Maintenance of Way at Springfield, Ill., has been transferred to succeed Mr. Trippeer as Engineer of Maintenance of Way of the Western division, with authority over the St. Louis division and headquarters at Moberly, Mo. The jurisdiction of Edward Shelah, Engineer of Maintenance of Way of the Middle division, with headquarters at Decatur, Ill., has been extended to include the Springfield division. Mr. Shelah thus succeeds Mr. Merriweather and Mr. Courter.

George G. Yeomans, heretofore Purchasing Agent of the Chicago, Burlington & Quincy, has been appointed Assistant to the First Vice-President. In this position, he will have charge of the purchasing and fuel departments of the entire system, including the Wabash-Pittsburg Terminal and Wheeling & Lake Erie.

The authority of J. B. Barnes, Superintendent of Motive Power and Machinery has been extended over the car department and the position of Master Car Builder has been abolished.

Wheeling & Lake Erie.—H. T. Douglas, Jr., Chief Engineer of the West Side Belt, has been appointed Consulting Engineer of the Wabash Lines east of Toledo. Mr. Douglas' duties as Chief Engineer of the West Side Belt will be taken over by George T. Barnsley, Chief Engineer of the Wabash lines east.

Yazoo & Mississippi Valley.—See Illinois Central.

LOCOMOTIVE BUILDING.

The Buenos Ayres & Rosario has ordered 22 compound six-wheel (2-4-0) passenger locomotives from Robert Stevenson & Co., of Darlington, England.

The Missouri, Kansas & Texas has ordered 14 simple mogul (2-6-0) locomotives, eight simple 10-wheel (4-6-0) locomotives and two balanced compound 10-wheel (4-6-0) locomotives from the Baldwin Locomotive Works, for September and October delivery, instead of 30 locomotives, as reported in our issue of June 23. The mogul locomotives will weigh 155,000 lbs., with 133,100 lbs. on the drivers; cylinders, 20 in. x 28 in.; diameter of drivers, 63 in.; wagon top boiler, with a working steam pressure of 200 lbs.; heating surface, 2,268 sq. ft.; 298 charcoal iron tubes, 2 in. in diameter and 12 ft. 8 in. long; Otis steel firebox, 101 in. x 60 in.; grate area, 46.2 sq. ft.; tank capacity, 7,500 gallons, and coal capacity, 28,000 lbs. The simple 10-wheel locomotives will weigh 145,000 lbs., with 105,000 lbs. on the drivers; cylinders, 19 in. x 26 in.; diameter of drivers, 68 in.; wagon top boiler, with a working steam pressure of 200 lbs.; heating surface, 2,372 sq. ft.; 295 iron tubes, 2 in. in diameter and 14 ft. 3 in. long; Otis steel firebox, 100⅛ in. x 41¼ in.; grate area, 29.1 sq. ft.; tank capacity, 6,500 gallons, and coal capacity, 12 tons. The compound 10-wheel locomotives will weigh 157,800 lbs., with 116,500 lbs. on the drivers; cylinders, 15 and 25 in. x 26 in.; diameter of drivers, 68 in.; wagon top boiler, with a working steam pressure of 200 lbs.; heating surface, 2,650 sq. ft.; 294 iron tubes, 2 in. in diameter and 16 ft. long; Otis steel firebox, 108⅛ in. x 41¼ in.; grate area, 31 sq. ft.; tank capacity, 6,500 gallons, and coal capacity, 12 tons. The special equipment for all will include: Westinghouse-American air-brakes, "Simplicity" bell ringer, National-Hollow brake-beams, Diamond "S" and steel insert brake-shoes, Buckeye tender couplers and Leeds reversible pilot couplers, Pyle-National electric headlights, Monitor injectors, U. S. metallic piston and valve rod packings, Coale safety valves, Leach pneumatic sanding devices, Nathan sight-feed lubricators, Railway Steel Spring Co.'s springs, Ashcroft steam gages, Standard Steel Works driving and truck wheel tires, and Safety Car Heating & Lighting Co.'s steam heat equipment for 10-wheel locomotives.

CAR BUILDING.

The Chicago & Eastern Illinois has ordered 26 cabooses from the Mt. Vernon Car Manufacturing Co.

The Chicago, Rock Island & Pacific has ordered 25 cabooses from the Mt. Vernon Car Manufacturing Co.

The Missouri, Oklahoma & Gulf has ordered 50 gondola cars of 60,000 lbs. capacity from the American Car & Foundry Co., for September delivery.

The El Paso & Southwestern has ordered 500 side steel dump coke cars of 100,000 lbs. capacity from the Pressed Steel Car Co., for December delivery. These cars will weigh approximately 45,000 lbs., and measure 40 ft. long and 9 ft. 8¼ in. wide, both inside measurements. The special equipment includes: Westinghouse air-brakes, Climax steel couplers, Miner tandem draft rigging, Harrison dust guards and McCord journal boxes.

The Chicago & North-Western, as reported in our issue of June 23, has ordered 500 refrigerator cars of 60,000 lbs. capacity from the Chicago Works of the American Car & Foundry Co. for August delivery. These cars are to measure 40 ft. long and 9 ft. wide over sills and 7 ft. 5 in. high from sill to plate, with wooden frames and underframes. The special equipment will include: Steel axles, Williamson & Priese bolsters, metallic brake-beams, Congdon brake-shoes, Westinghouse air-brakes, Chicago & North-Western standard brasses, draft rigging, roofs and trucks, Chicago steel couplers and cast-iron journal boxes and wheels.

The United Railroads of San Francisco, as reported in our issue of June 16, have ordered 50 California type combination cars from the St. Louis Car Co., for September 15 delivery. These cars will weigh 14,700 lbs. and have a seating capacity for 42 persons. They will measure 13 ft. 2 in. long, and 8 ft. 2 in. wide, inside measurements; 4 ft. 6 in. long, and 9 ft. 7 in. wide, over all, and 11 ft. 7 in. high from rail, with wooden frames and wood and steel underframes. The special equipment includes: Jones & Laughlin axles; United Railroads of San Francisco standard bolsters, hand wheel and track brakes and couplers; Peckham brake-beams, brake-shoes, brasses, journal boxes, springs and trucks; National Electric Co.'s air-brakes, Pantasote curtain material, St. Louis Car Co.'s door fastenings and doors, incandescent lights, Felton-Sibley Co.'s Tuscan red paint, Monitor canvas roofs and Griffin Wheel Co.'s wheels.

BRIDGE BUILDING.

Bedford, N. S.—Bids, it is said, will soon be asked by the Intercolonial for building a railroad bridge to carry double track at this place, to cost about $50,000.

Bloomsburg, Pa.—The viewers on the proposed State bridge at Mifflinville have decided to report favorably on an overgrade crossing of the tracks of the Pennsylvania Railroad. The bridge will be 1,421 ft. long, 125 ft. of which is made necessary by the overgrade crossing. It will have a 24-ft. roadway, and 6-ft. walk.

Bracebridge, Ont.—Bids are wanted by Alex. C. Salmon, town clerk, for building a steel bridge 190 ft. long, with 20-ft. roadway and 6-ft. walk on cement abutments. Plans at the office of the Engineer, Public Works Department, Toronto, Ont.

Decatur, Ill.—The Highway Commissioners have under consideration the question of replacing the old wooden bridge over the Sagamon river at this place with a steel structure to cost about $15,000.

Falls City, Neb.—Bids are wanted July 14 by J. C. Tanner, County Clerk, for some bridge work in Richardson County.

Greensburg, Pa.—The county commissioners have given a contract for the new bridge over the Youghiogheny River at West Newton to the Pope Bridge Co., of Beaver Falls, at $67,885.

Haverhill, Mass.—The bids recently opened at the office of the County Commissioners at Salem for the new bridge at Haverhill varied from that of the American Bridge Co.'s bid of $177,950 (the lowest bidder) to $204,000.

Lancaster, Pa.—The Lancaster & Eastern, which is building an electric line from Lancaster to Christiania, via Gap, will build bridges over Conestoga creek near Witmer's, and just east of Leaman Place.

Lyme, Conn.—The plans for the new bridge of the New York, New Haven & Hartford over the Connecticut river have been approved by the Federal authorities, and it is reported that the bridge will be built in one year.

Manitowoc, Wis.—A bridge may be built at Tenth street at a cost of $50,000 by the Fox River Valley Railway Co.

St. Louis, Mo.—An ordinance is being prepared authorizing a vote to be taken on the question of appropriating about $5,000,000 for building a free municipal bridge over the Mississippi river.

Sandusky, Ohio.—Bids are wanted July 10 by the Board of County Commissioners for building a steel and concrete arch in Oxford township, Erie County. Charles Kubach is Auditor.

Sherman, Tex.—The Houston & Texas Central, it is said, is

planning to replace many of its old bridges along the line of its road between this place and Dallas with new structures.

WAYNESBORO, PA.—The Western Maryland has given the Pennsylvania Steel Co. a contract for the reconstruction of four bridges on the main line and two on the West Virginia Central, as follows: Main Line—Over Marsh Run, near Hagerstown, to be of 43½ deck-plate girder spans; over Antietam Creek, east of Hagerstown, to have two 75-ft. deck plate girder spans; over Coconocoocheague Creek, near Williamsport, to have four 80-ft. 6-in. deck-plate girder spans; over Little Conococheague Creek, West Virginia Central-Gerstell Bridge, to have two 120 ft. through riveted truss spans and two 32-ft. 10-in. deck-plate girder spans; Dawson Bridge, to have one 120-ft. through riveted truss span and two 54-ft. 4-in. deck-plate girder spans. All the work to be finished by December 1.

WEBSTER SPRINGS, W. VA.—Bids are wanted July 13 by P. M. McElwain, Clerk of the County Court, for building an iron bridge 100 ft. long over the Elk river in Webster County.

YORK, PA.—The York Street Railway Co. will build a subway 360 ft. long, 30 ft. wide, and 13 ft. high, under the Northern Central tracks at Richland avenue.

Other Structures.

CHAMPAIGN, ILL.—The Cleveland, Cincinnati, Chicago & St. Louis, it is said, is planning to put up a new passenger station at this place, to cost about $25,000; also a new freight house.

CHICAGO, ILL.—The Chicago & Western Indiana, it is said, will build a new station at 47th street, to cost about $50,000; also one at 55th street.

EL PASO, TEX.—Plans are being made for new shops for the joint use of the El Paso & Southwestern and the El Paso-Northeastern, to consist of brick and steel structures and a machine shop, 127 x 323 ft., repair shop 110 x 300 ft., blacksmith shop 80 x 100 ft., power house 50 x 100 ft., a mill 100 x 200 ft., a 20-stall roundhouse and some other buildings.

EVERETT, WASH.—The Great Northern, it is said, is planning to put up a brick passenger station here.

HILLYARD, WASH.—The Great Northern, it is reported, will spend about $300,000 in improvements at this place, to include a new freight house and improvements to its roundhouse and yards.

JOHNSON CITY, TENN.—The Southern, it is reported, has plans ready for putting up a new passenger station at this place.

MONROE, N. C.—The Seaboard Air Line is planning to put up a new passenger station and freight house to cost about $60,000.

NEW YORK, N. Y.—Plans have been made by Bridge Commissioner Best and submitted to the Board of Estimate for building a new terminal at the Manhattan end of the Brooklyn Bridge, to double its present capacity, at a cost of about $5,000,000.

PORT RICHMOND, N. Y.—The Philadelphia & Reading has given a contract to the Millard & McGraw Construction Co. for putting up a brick office building two stories high.

VANCOUVER, B. C.—A large terminal depot, it is reported, will be built by the Great Northern at this place.

RAILROAD CONSTRUCTION.

New Incorporations, Surveys, Etc.

APALACHICOLA NORTHERN.—A contract has been given by this company to the Morey Engineering & Construction Co., of St. Louis, Mo., to build its road from St. Joseph Bay, Fla., east to Apalachicola, and thence north to River Junction, a distance of about 80 miles.

BLUFFTON & FORT WAYNE (ELECTRIC).—Bonds have recently been issued by this company, the proceeds of which are to be used to extend the Muncie, Hartford & Fort Wayne from Bluffton north to Fort Wayne, Ind., a distance of 25 miles.

BRONX, YONKERS & WHITE PLAINS.—Application has been made by a company under this name in New York for a franchise to build an electric road from the Borough of the Bronx, New York City, north to White Plains, about 15 miles.

BROOKVILLE & MAHONING (PITTSBURG, SHAWMUT & NORTHERN).—This company has begun the construction of its road from Hyde, in Elk County, Pa., at which point connection will be made with the Pittsburg, Shawmut & Northern, southwest through Brookville to Freeport, on the Pennsylvania, a distance of about 103 miles. W. P. Mulhern, George S. Ramsey, E. B. Tilden and others, of St. Mary's, are interested.

BUFFALO, LAKE ERIE & NIAGARA.—A charter has been granted this company in New York, with a capital of $4,000,000, to build a railroad around Buffalo, from a point on the shore of Lake Erie southwest of Buffalo through the towns of Hamburg, West Seneca and Amherst to the Niagara river at Tonawanda, and thence to the International bridge at Buffalo. The directors include: C. N. Bushnell, J. H. Metcalf and H. W. Putnam, of Buffalo.

CARLINVILLE, ALTON & ST. LOUIS.—Incorporation has been asked by this company in Illinois with headquarters in Jerseyville to build a railroad from Carlinville southwest to Jerseyville, and thence south to Alton, about 50 miles. The incorporators and first board of directors include: Andrew J. Gross, J. M. Page, J. W. Becker, J. C. McGrath, all of Jerseyville; A. L. Austen, of Chicago; Robert Curdie and J. M. Rhoades, of Alton, Ill.

CHICAGO & NORTH-WESTERN.—A contract has been given by this company to Kilpatrick Bros. & Collins at about $750,000 to build an extension of its road from Casper, Wyo., west to the edge of the Shoshone reservation, a distance of about 135 miles. (See Construction Record.)

COLORADO, TEXAS & MEXICO.—The stockholders of this company will vote on July 10 on issuing bonds, in conformity with the ruling of the Texas Railroad Commission, to build 400 miles of road from Wilbarger County, Tex., to a connection with the San Antonio & Aransas Pass, near Comfort; also to build a line from Washburn, Tex., connecting with the Fort Worth & Denver City, the Atchison and the Rock Island, to San Antonio.

GREAT NORTHERN.—Contracts have been given by this company to Owens & Loveland, of Omaha, Neb., for the first 10 miles of its extension north from Ashland, Neb. Callahan Bros. and Phelan & Shirley, of Omaha, have the contract for building 50 miles near Yutan and in the Winnebago reservation. Work is to be begun at once at Sioux City, Freemont, and Ashland, and the contracts call for the completion of the work before November 1. Contracts for the balance of the extension, which is to be 105 miles long, it is said, have been given to St. Paul contractors.

KANSAS, OKMULGEE & GULF.—This company, which has a capital of $2,500,000, recently filed a mortgage for $3,000,000 to raise funds to build its projected road from Kansas City south through the Cherokee, Creek and Choctaw nations, to a point on the Red river near the 96th meridian. A branch line is also to be built from Okmulgee, Ind. T., northeast to Joplin, Mo., a total distance of about 560 miles. F. H. Smith, of Okmulgee, Ind. T., is President.

MEXICAN CENTRAL.—This company is reported to have let the contract to Hampson & Smith, of the City of Mexico, for building the extension of its branch which terminates at Tuxpan to the port of Manzanillo, on the Pacific coast. As reported in last week's issue of the *Railroad Gazette*, the Mexican Central has an option until September 6 on the Mexican National Construction Co.'s line, which runs from Colima to Manzanillo, 89 miles. If the option is exercised and this road taken over, there will be about 40 miles of line from Tuxpan to Colima to be built to complete the line to Manzanillo. On the other hand, a new line from Tuxpan to Manzanillo would be about 125 miles long.

MISSISSIPPI VALLEY & GULF.—Incorporation has been granted a company under this name in Oklahoma, with a capital of $50,000,000. Its headquarters are at Guthrie, Okla. T., and at Chicago, Ill. It is proposed to build a railroad from Keokuk, Iowa, southwest through Missouri to a point on the Arkansas river in Arkansas. The incorporators include: E. L. Cochanour and S. S. Cochanour, of Keokuk; G. P. Dalton, of Muscatine; G. A. Mason and T. Rockenfeller, of Chicago, and H. W. Pentecost and I. M. Louden, of Guthrie.

NATIONAL OF MEXICO.—The new line of this company from Monterey, Mex., east to Matamoras, which was operated as far as Los Aldamas, about 83 miles, last year, has been completed to Metamoras, a total distance of 205 miles.

NORTHERN PACIFIC.—A contract has been let by this company to Donald Grant, of Faribault, for building the first 15 miles of its proposed extension from Denhoff, N. Dak., west to Coalharbor, in McLean County, a distance of 54 miles.

OKLAHOMA INTERURBAN (ELECTRIC).—An officer writes that this company is in the market for material for building about three miles of electric railway, and also that the company is planning to continue its line to Lexington, a distance of 40 miles. C. V. Eggleston, Oklahoma City, Okla. T., is President and General Manager.

OPELOUSAS, GULF & NORTHEASTERN.—An officer writes that the chances are good for building this road from Melville, La., to Opelousas, and that contracts may be let for the work in about 60 days. There will be only one steel bridge. T. H. Lewis is President and Ira W. Sylvester is Chief Engineer, both of Opelousas.

PENNSYLVANIA.—A contract has been given by this company to the Millard & McGraw Construction Co., of Philadelphia, for double tracking and straightening the tracks of its Princeton branch, on which work is to begin at once. This branch, which is about three miles long, is to be made double-track throughout.

Surveys, it is reported, are being made by this company for building a new freight line around Baltimore. The new line is to be about 10 miles long, and will be a surface road the entire dis-

tance, leaving the main line of the Philadelphia, Baltimore & Washington at Stemmer's Run. A connection is to be made with the Frederick Road extension on the south side of Baltimore.

Public Service Corporation.—This company is said to be planning to build a high-speed electric road from Newark, N. J., to New York City.

Rockland, Jasper & North-Western.—A charter has been granted this company in Texas, with a capital of $100,000 to build a railroad from Rockland, in Tyler County, Tex., east to Jasper, in Jasper County, approximately 25 miles. The incorporators include: W. W. Kyle, S. K. Stone, W. W. Cunningham and others, of Beaumont.

St. Paul & Des Moines.—This company has been organized in Iowa with a capital of $1,000,000, to build a railroad from Iowa Falls to the Minnesota state line, with certain branches. The headquarters of the company will be at Iowa Falls. This is to be the construction company for the proposed extension of the Des Moines, Iowa Falls & Northern from Iowa Falls to Mason City, or Charles City, Iowa, a distance of about 110 miles. The incorporators are: E. S. Ellsworth, William Welden, W. J. Souder, of Iowa Falls, and W. H. Tylee and W. A. W. Dodge, of Boston, Mass. (See Construction Record.)

Spokane International.—An officer writes that contracts have been let for building this proposed road from Spokane to the international boundary line, where connection will be made with the Canadian Pacific. The work includes some heavy sections, and it is not yet known just what bridges will be put up or tunnels pierced. C. W. Chapin, of New York, is President, and E. G. Tabor, Chief Engineer.

Trinity & Brazos Valley.—An amendment to its charter has been filed by this company, which was recently bought by the Colorado & Southern, contemplating the building of an extension from the northern terminus at Cleburne, in Johnson County, north to Forth Worth, and thence east to Dallas, about 65 miles; also for a line from a point near Maxia north to Dallas, approximately 80 miles, and for an extension from the southern terminus at Maxia to Galveston, via Houston, about 200 miles, with an extension eastward towards Louisiana, passing through Beaumont to Orange, on the state line, about 110 miles.

Vinita & Western.—A charter has been granted this company in Oklahoma Territory to build a railroad from Vinita, Ind. T., northwest through the Cherokee nation, and through the counties of Montgomery, Chautauqua and Cowley in Kansas, a distance of about 140 miles; also to build two branches, one 20 miles and the other 85 miles. The incorporators include: F. R. Pierce, of St. Louis; C. C. Nelson, of Fort Scott; G. F. Badgett, of Tonopah, Nev.; L. F. Parker, Jr., of Vinita; J. S. Mabon, of Guthrie; M. P. Libby and A. Schoenhart, of El Reno.

RAILROAD CORPORATION NEWS.

Baltimore & Ohio.—The Staten Island Rapid Transit Railroad Co., which is controlled by the Baltimore & Ohio, has been authorized by the New York State Railroad Commission to issue $5,000,000 in new bonds. Of this amount, $3,500,000 is to be used to refund $1,000,000 first-mortgage 6 per cent. bonds of the old S. I. R. T. R. R. Co., due 1913, and $2,500,000 second-mortgage 4 per cent. bonds due July 1, 1904.

Central of New Jersey.—This company is reported to have bought control of the New Jersey & Pennsylvania, which runs from Whitehouse, N. J., on the Central of New Jersey, north to Morristown, 27 miles. Up to a few months ago the name of the road was the Rockaway Valley.

Chicago & Alton.—The Chicago & Alton Railroad Co. has sold to Kuhn, Loeb & Co., $5,000,000 3 per cent. fifty-year refunding bonds. These are issued for betterments and are part of an authorized issue of $45,350,000, of which $37,388,000 have already been issued. The authorized issue was increased from $40,000,000 in September, 1904. The Chicago & Alton Railway Co. owns more than 98 per cent. of the stock of the Chicago & Alton Railroad Co.

Chicago & Eastern Illinois.—The stockholders of this company have ratified the proposed issue of $55,000,000 fifty-year 4 per cent. bonds, redeemable at 102½. Of these bonds $34,626,000 will be used for refunding purposes.

Chicago & North-Western.—Permission has been given by the New York Stock Exchange to list $10,609,200 additional common stock from time to time on official notification that it has been issued and paid in full. This will make the total amount issued $59,949,900.

Chicago Terminal Transfer.—This company has again defaulted on its 4 per cent. bonds. The previous default was in January. Under the mortgage, the holders of 50 per cent. of the bonds may now foreclose on account of the January default. It has been stated that the road will be sold to one of several different railroads entering Chicago, but there appears to be no authoritative information at present as to which of these will get the property.

Cleveland, Cincinnati, Chicago & St. Louis.—Gross earnings for the quarter ended June 30 were $5,225,900, a decrease of $226,300 from 1904. Operating expenses were $3,928,600, and net earnings, $1,297,300, a decrease of $227,800 from 1904. For the six months ended June 30, gross earnings were $10,154,800, an increase of $155,000, and net earnings, $2,210,000, a decrease of $16,900. All earnings for 1905 are partly estimated.

Consolidated Railway (N. Y., N. H. & H.).—The Consolidated Railway has bought the Branford Light & Water Co.'s trolley line, five miles long, from East Haven, Conn., to Branford. The Branford Company has an authorized capital stock of $600,000, only half of which has been issued. The road has been operated by the Fairhaven & Westville, one of the Consolidated properties. The price paid is said to have been about $80 per $100 share for the $300,000 stock, and the payment to have been made in 4 per cent. Consolidated Railway debentures.

East Tennessee & Western North Carolina.—The stockholders have authorized a new issue of $500,000 in bonds to pay the present bonded indebtedness and to buy four miles of railroad in Mitchell County, N. C.

Green Bay & Western.—A committee representing a considerable amount of the "B" debentures is asking, by advertisement, deposits of these securities for the purpose of obtaining income alleged to belong to the owners of these obligations and securing their interests on any transfer of the property. The advertisement states that the net earnings are sufficient to pay a substantial percentage on the "B" debentures after full payments on all prior claims. When the road was reorganized at foreclosure sale in 1895, its securities were exchanged for "A" and "B" debentures and stock. After 2½ per cent. has been paid each on the "As" and the stock, and the two have in addition shared equally in the surplus up to 5 per cent. each, all surplus earnings are according to the reorganization plan to go to holders of the "Bs."

Long Island.—Application has been made to the New York Stock Exchange to list $5,691,000 additional refunding mortgage 4 per cent. bonds of 1949. This will make the total amount listed $17,891,000.

New York Central & Hudson River.—The lease of the Beech Creek Extension Railroad to the New York Central is reported to provide that the Central shall pay 3½ per cent. interest on the outstanding $3,500,000 bonds issued in 1901 and 4 per cent. on an issue limited to $20,000,000 of consolidated mortgage bonds which is to be made. The Beech Creek Extension is a recent consolidation of the Beech Creek Extension, Curwensville & Bower, Pittsburg & Eastern, and Clearfield Southern, all controlled by the New York Central.

New York, Ontario & Western.—A new mortgage to secure $12,000,000 4 per cent. fifty-year gold bonds has been made by this company to the New York Trust Company, trustee.

Philadelphia & Reading.—Gross earnings of the Philadelphia & Reading for May were $3,550,477, against $2,956,570 in 1904. Net earnings were $1,522,398, against $1,109,284 in 1904. Dividend payments are now at the rate of 4 per cent. a year.

Raleigh & Southport.—This company, formerly the Raleigh & Cape Fear, whose road runs from Raleigh, N. C., southeast to Lillington, 35 miles, has made a mortgage to the Knickerbocker Trust Co., of New York, as trustee, to secure $2,000,000 5 per cent. bonds. An extension to Fayetteville, 50 miles, and probably to Southport, 90 miles further, is to be built.

St. Louis & San Francisco.—The Beaumont, Sour Lake & Western, a road 22 miles long, which runs from Brownsville to Sour Lake, in Texas, has been sold to the St. Louis & San Francisco, or to the Yoakum interests. Colonel R. C. Duff, of Beaumont, Tex., will, it is reported, be elected President of the road. G. W. Meeker, who is now President, has stated that all the stock of the road and the majority of the bonds have changed hands, and that the new owners will soon assume charge of the property.

Western Pacific.—A meeting of the stockholders has been called for August 23 to vote on a proposition to increase the capital stock of the company from $50,000,000 to $75,000,000. This increase, it is said, is to reimburse the Denver & Rio Grande for advances which it may be called upon to make for building branch lines in California for the Western Pacific. By the terms of the issue of $50,000,000 first-mortgage bonds, if the proceeds of that issue are not sufficient to pay all the cost of construction, including branch lines, the necessary funds are to be provided by the issue of junior securities.